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SECTION 01 4216
DEFINITIONS, REFERENCES AND ABBREVIATIONS

PART 1 - GENERAL

1.1 DEFINITIONS

A. General Explanation: Specification language often includes terms that are defined elsewhere in the Contract Documents, including the Construction Contract Clauses. Certain terms are defined in this section. These definitions or explanations are not necessarily complete or exclusive, but are general for the Work and may be explained more explicitly in other Sections.

B. General: Basic Contract definitions are included in the General Conditions, Section 00 7200.

C. "Approved" when used to convey Design Professional's action on Contractor's submittals, applications, and requests, "approved" is limited to the Design Professional's duties and responsibilities as stated in the Agreement between the Owner and the Design Professional.

D. "Contract Sum" is stated in the agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

E. "Design Professional" is retained by the Owner and is an individual or entity that is licensed to practice engineering and/or architecture in the jurisdiction where the Project is located. That person is referred to throughout the documents as if singular in number.

F. "Directed" is a command or instruction by the Design Professional. Other terms including "requested," "authorized," "selected," "required" and "permitted" have the same meaning as "directed" and are limited to the Design Professional's duties and responsibilities as stated in the Agreement between the Owner and Design Professional.

G. "Furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembling, installation and similar operations.

H. "Guarantee" means to give assurance in writing that the work or product will be free of defect for the stated period of time.

I. "Indicated" refers to graphic representations, notes or schedules on the Drawings, or to requirements elsewhere in the Specifications or other Contract Documents. Terms such as "shown", "noted", "scheduled" and "specified" have the same meaning as "indicated" and are used to further help locate the reference, but no limitation on location is intended except as specifically stated.

J. "Install" describes operations at the Project site, including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.

K. "Installer" is the Contractor or another entity engaged by the Contractor, either directly or indirectly through subcontracting, to perform a particular construction operation at the Project site, including installation, erection, application and similar operations. Installers shall be skilled in the operations they perform. Where indicated, installers shall also be Specialists as defined in the Construction Contract Clauses.

L. "Project site" refers to the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing other work.
M. "Provide" means to furnish and install, complete in place and ready for full use.

N. "Regulations" include laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as rules, conventions and agreements within the construction industry that control performance of the Work.

O. "Testing agency" or "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report the results of those inspections and tests.

P. “Warranty” Refer to “Guarantee.”

1.2 REFERENCES

A. Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect, to the extent referenced, as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

B. Unless specifically noted in the reference, comply with the standards in effect as of the date of the Contract Documents.

C. Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantity or quality, comply with the most stringent requirement. Immediately refer uncertainties, and requirements that are different but apparently equal, to the Owner in writing for a decision before proceeding.

1.3 ABBREVIATIONS

A. Abbreviations: Names and titles of standards are frequently abbreviated. Abbreviations and acronyms used in the Specifications and other Contract Documents mean the associated names. The following names are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.
   1. AA - Aluminum Association
   2. AABC - Associated Air Balance Council
   3. AAMA - American Architectural Manufacturers Association
   4. AAN - American Association of Nurserymen (See ANLA)
   5. ABMA - American Bearing Manufacturers Association
   6. ABMA - American Boiler Manufacturers Association
   7. ACI - American Concrete Institute
   8. ACPA - American Concrete Pipe Association
   9. ADC - Air Diffusion Council
   10. AEIC - Association of Edison Illuminating Companies
   11. AFBMA - Anti-Friction Bearing Manufacturers Association (See ABMA)
   12. AGA - American Gas Association
   13. AHA - American Hardboard Association
   14. AI - Asphalt Institute
   15. AIA - The American Institute of Architects
   16. AIA - American Insurance Association
   17. AIHA - American Industrial Hygiene Association
   18. AISC - American Institute of Steel Construction
   19. AISI - American Iron and Steel Institute
20. AITC - American Institute of Timber Construction
21. ALA - American Laminators Association (See LMA)
22. ALCA - Associated Landscape Contractors of America
23. ALSC - American Lumber Standards Committee
25. ANLA - American Nursery and Landscape Association
26. ANSI - American National Standards Institute
27. APA - American Plywood Association (see EWA)
28. APA - Architectural Precast Association
29. API - American Petroleum Institute
30. ARI - Air-Conditioning and Refrigeration Institute
31. ARMA - Asphalt Roofing Manufacturers Association
32. ASA - Acoustical Society of America
33. ASC - Adhesive and Sealant Council
34. ASCA - Architectural Spray Coaters Association
35. ASCE - American Society of Civil Engineers
36. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
37. ASLA - American Society of Landscape Architects
38. ASME - American Society of Mechanical Engineers
39. ASPA - American Sod Producers Association (See TPI)
40. ASPE - American Society of Plumbing Engineers
41. ASPE – American Society of Pharmaceutical Engineers
42. ASQ - American Society for Quality
43. ASSE - American Society of Sanitary Engineering
44. ASTM - American Society for Testing and Materials
45. ATIS - Alliance for Telecommunications Industry Solutions
46. AWCI - Association of the Wall and Ceiling Industries International
47. AWCMCA - American Window Covering Manufacturers Association (See WCMA)
48. AWI - Architectural Woodwork Institute
49. AWPA - American Wood-Preservers’ Association
50. AWS - American Welding Society
51. AWWA - American Water Works Association
52. BAC - Brick Association of the Carolinas
53. BHMA - Builders Hardware Manufacturers Association
54. BIA - Brick Industry Association
55. CABO - Council of American Building Officials
56. CAGI - Compressed Air and Gas Institute
57. CBMA - Certified Ballast Manufacturers Association
58. CCC - Carpet Cushion Council
59. CDA - Copper Development Association Inc.
60. CE - Corps of Engineers
61. CFR - Code of Federal Regulations
62. CGA - Compressed Gas Association
63. CISCA - Ceilings and Interior Systems Construction Association
64. CISPI - Cast Iron Soil Pipe Institute
65. CLFMI - Chain Link Fence Manufacturers Institute
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<td>68.</td>
<td>CPSC</td>
<td>Consumer Product Safety Commission</td>
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<td>CRI</td>
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<td>CS</td>
<td>Commercial Standard (U.S. Department of Commerce)</td>
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<td>72.</td>
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<td>74.</td>
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<td>75.</td>
<td>DASMA</td>
<td>Door and Access Systems Manufacturers Association, International</td>
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<td>DHI</td>
<td>Door and Hardware Institute</td>
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<tr>
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<td>DIPRA</td>
<td>Ductile Iron Pipe Research Association</td>
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<td>78.</td>
<td>DOT</td>
<td>Department of Transportation</td>
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<td>79.</td>
<td>EIA</td>
<td>Electronic Industries Association</td>
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<td>80.</td>
<td>EIMA</td>
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<td>81.</td>
<td>EJMA</td>
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<td>82.</td>
<td>EPA</td>
<td>Environmental Protection Agency</td>
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<td>83.</td>
<td>ETL</td>
<td>ETL Testing Laboratories Inc. (see ITS)</td>
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<td>84.</td>
<td>EWA</td>
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<td>85.</td>
<td>FAA</td>
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<td>87.</td>
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<td>FM</td>
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<td>GA</td>
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<td>96.</td>
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<td>97.</td>
<td>HEI</td>
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<td>HFES</td>
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<td>HI</td>
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<td>104.</td>
<td>IBD</td>
<td>Institute of Business Designers (See IIDA)</td>
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<td>110.</td>
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<td>Institute of Electrical and Electronics Engineers</td>
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<td>111.</td>
<td>IESNA</td>
<td>Illuminating Engineering Society of North America</td>
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112. IFC – International Fire Code
113. IFGC – International Fuel Gas Code
114. IGCC - Insulating Glass Certification Council
115. IIDA - International Interior Design Association
116. ILI - Indiana Limestone Institute of America
117. IMC – International Mechanical Code
118. IMSA - International Municipal Signal Association
119. INCE - Institute of Noise Control Engineering
120. IPC – International Plumbing Code
121. IRI - HSB Industrial Risk Insurers
122. ISA - International Society for Measurement and Control
123. ISEA - Industrial Safety Equipment Association
124. ISPSC – International Swimming Pool and Spa Code
125. ISS - Iron and Steel Society
126. ITS - Intertek Testing Services
127. KCMA - Kitchen Cabinet Manufacturers Association
128. LGSI - Light Gage Structural Institute
129. LIA - Lead Industries Association, Inc.
130. LMA - Laminating Materials Association
131. LPI - Lightning Protection Institute
132. MBMA - Metal Building Manufacturers Association
133. MCAA - Mechanical Contractors Association of America
134. MFMA - Maple Flooring Manufacturers Association
135. MFMA - Metal Framing Manufacturers Association
136. MHIA - Material Handling Industry Association
137. MIA - Marble Institute of America
138. MIA - Masonry Institute of America
139. MIL - Military Standardization Documents (U.S. Department of Defense)
140. ML/SFA - Metal Lath/Steel Framing Association
141. MRCA - Midwest Roofing Contractors Association
142. MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
143. NAA - National Arborist Association
144. NAAMM - National Association of Architectural Metal Manufacturers
145. NAAMM - North American Association of Mirror Manufacturers (See GANA)
146. NACE - National Association of Corrosion Engineers International
147. NAGDM - National Association of Garage Door Manufacturers (See DASMA)
148. NAIMA - North American Insulation Manufacturers Association
149. NAMI - National Accreditation & Management Institute, Inc.
150. NAPA - National Asphalt Pavement Association
151. NBHA - National Builders Hardware Association (See DHI)
152. NBGQA - National Building Granite Quarries Association, Inc.
153. NCAC - National Council of Acoustical Consultants
154. NCCA - National Coil Coaters Association
155. NCMA - National Concrete Masonry Association
156. NCPI - National Clay Pipe Institute
157. NCRPM - National Council on Radiation Protection and Measurements
158. NCSPA - National Corrugated Steel Pipe Association
159. NEBB - Natural Environmental Balancing Bureau
160. NECA - National Electrical Contractors Association
161. NEI - National Elevator Industry
162. NELMA - Northeastern Lumber Manufacturers Association
163. NEMA - National Electrical Manufacturers Association
164. NETA - InterNational Electrical Testing Association
165. NFPA - National Fire Protection Association
166. NFPA - National Forest Products Association (See AFPA)
167. NFRC - National Fenestration Rating Council Incorporated
168. NGA - National Glass Association
169. NHLA - National Hardwood Lumber Association
170. NIA - National Insulation Association
171. NIAC - National Insulation and Abatement Contractors Association (See NIA)
172. NIST - National Institute of Standards and Technology
173. NKCA - National Kitchen Cabinet Association (See KCMA)
174. NLGA - National Lumber Grades Authority
175. NOFMA - National Oak Flooring Manufacturers Association
176. NPA - National Parking Association
177. NPCA - National Paint and Coatings Association
178. NRCA - National Roofing Contractors Association
179. NRMCA - National Ready Mixed Concrete Association
180. NSA - National Stone Association
181. NSF - National Sanitation Foundation International
182. NSSEA - National School Supply and Equipment Association
183. NTMA - National Terrazzo and Mosaic Association
184. NUSIG - National Uniform Seismic Installation Guidelines
185. NWMA - National Woodwork Manufacturers Association (See NWWDA)
186. NWWDA - National Wood Window and Door Association
187. OSHA - Occupational Safety and Health Administration
188. PATMI - Powder Actuated Tool Manufacturers' Institute
189. PCA - Portland Cement Association
190. PCI - Precast/Prestressed Concrete Institute
191. PDCA - Painting and Decorating Contractors of America
192. PDI - Plumbing and Drainage Institute
193. PEI - Porcelain Enamel Institute
194. PGI - Polyvinylchloride Geomembrane Institute - Technology Program, University of Illinois-Urbana Champaign
195. PIMA - Photographic and Imaging Manufacturers Association
196. PPFA - Plastic Pipe and Fittings Association
197. PPI - Plastics Pipe Institute (The Society of the Plastics Industry, Inc.)
198. PS - Product Standards of the National Bureau of Standards
199. RCMA - Roof Coatings Manufacturers Association Center Park
200. RCSC - Research Council on Structural Connections
201. Sargent & Lundy
202. RFCI - Resilient Floor Covering Institute
203. RMA - Rubber Manufacturers Association
204. RUS - Rural Utilities Service
205. SAE - Society of Automotive Engineers International
206. SDI - Steel Deck Institute
207. SDI - Steel Door Institute
208. SEFA - Scientific Equipment and Furniture Association
209. SEGD - Society for Environmental Graphic Design
210. SGCC - Safety Glazing Certification Council
211. SHLMA - Southern Hardwood Lumber Manufacturers Association (See HMA)
212. SIGMA - Sealed Insulating Glass Manufacturers Association
213. SJI - Steel Joist Institute
214. SMA - Screen Manufacturers Association
215. SMACNA - Sheet Metal and Air Conditioning Contractors’ National Association
216. SPI - The Society of the Plastics Industry, Inc.
217. SPIB - Southern Pine Inspection Bureau
218. SPRI - Single Ply Roofing Institute
219. SSINA - Specialty Steel Industry of North America
220. SSPC - Steel Structures Painting Council - The Society for Protective Coatings
221. SSPMA - Sump and Sewage Pump Manufacturers Association
222. STI - Steel Tank Institute
223. SWI - Steel Window Institute
224. SWPA - Submersible Wastewater Pump Association
225. SWRI - Sealant, Waterproofing and Restoration Institute
226. TCA - Tile Council of America
227. TFS - Texas Forest Service
228. TINA - Thermal Insulation Manufacturers Association (See NAIMA)
229. TPI - Truss Plate Institute
230. TPI - Turfgrass Producers International
231. TRB - Transportation Research Board - National Research Council
232. UFAC - Upholstered Furniture Action Council
233. UL - Underwriters Laboratories Inc.
234. UNI - Uni-Bell PVC Pipe Association
235. USDA - U.S. Department of Agriculture
236. USITT - U.S. Institute of Theater Technology - The American Association of Design and Production Professionals in the Performing Arts
237. USP - U.S. Pharmacopeia
238. USPS - U.S. Postal Service
239. WA - Wallcoverings Association
240. WASTE - Waste Equipment Technology Association
241. WCLIB - West Coast Lumber Inspection Bureau
242. WCMA - Window Covering Manufacturers Association
243. WEF - Water Environment Federation
244. WIC - Woodwork Institute of California
245. WMMPA - Wood Moulding & Millwork Producers Association
246. WPCF - Water Pollution Control Federation (See WEF)
247. WRI - Wire Reinforcement Institute
248. WSC - Water Systems Council
249. WSFI - Wood and Synthetic Flooring Institute (See MFMA)
250. WWPA - Western Wood Products Association

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 4216
SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project, including manufacturers' standard warranties on products and special warranties.

B. For products specified only by reference or performance standards, select any product which meets or exceeds standards, by any manufacturers, subject to the Engineer's approval.

C. For products specified by naming several products or manufacturers, select any product and manufacturer named. Only those products or manufacturers named shall be considered acceptable except if approved based on a formal Substitution Request as defined hereinafter.

D. The following definitions are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms that are self-explanatory and have well-recognized meanings in the construction industry.
1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and other terms of similar intent.
2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" are products with operational parts, whether motorized or manually operated, and products that require service connections, such as wiring or piping.

E. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:
1. Revisions to the Contract Documents requested by the Owner.
2. Specified options for products and construction methods included in the Contract Documents.
3. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

F. Warranties: Standard and special warranties required by the individual sections of the Specifications shall provide guarantees in terms of time limits or rights of the Owner in addition to those contained in the Construction Contract Clauses.
1. Standard product warranties shall be preprinted written warranties published by individual manufacturers for particular products, and shall be specifically endorsed to the Owner by the manufacturer.
2. Special warranties shall be specifically written to incorporate particular requirements of the Contract Documents, and shall be endorsed to the Owner by the entities responsible for the work, as stated in the individual section.

1.2 SUBSTITUTIONS

A. General
1. To obtain approval to use products not listed in the Specification prior to bid opening, the substitution request shall be submitted at least 7 calendar days before bid due date.

2. Intention is to establish a standard of quality, performance and size. All substitutions are subject to owner approval.

3. Where other acceptable manufacturers are listed, products shall be of similar design, equal to item specified and comply with specification requirements.

4. Where Contractor chooses to use an approved item other than that detailed or specified, the Contractor shall be responsible for coordinating necessary changes in other Work and pay all additional costs.

5. Items specified by reference to a Commercial Standard, Federal Specification, trade association standard, or other similar standard, shall comply with the requirements for design, manufacture, and installation of the latest revision thereto in effect on the date of the Project Manual. Where specifications require a better quality than such standard, the specifications shall govern.

B. Pre-bid Substitution Request Submittal: The Owner will consider requests for substitution prior to bid opening in accordance with the following requirements:

1. Submit Substitution Request to the Owner and Design Professional via electronic file transfer using portable document format (pdf).

2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.

3. Provide complete documentation showing compliance with the Project requirements and the following information, as appropriate:
   a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors that will be necessary to accommodate the proposed substitution.
   b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as performance, weight, size, durability, visual effect and installation space requirements.
   c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
   d. Samples, where applicable.
   e. Certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.

4. All substitution requests are subject to Owner approval. Acceptance will be in the form of an addendum issued prior to the bid opening. If the Substitution Request is not acknowledged in an addendum, the Substitution Request has not been approved.

1.3 SUBMITTALS

A. General

1. Provide submittals for all products as required by the technical sections of this Specification.

2. All submittals shall be electronic and transmitted in accordance with the procedures established at the beginning of the project. Transmitted documents shall be in portable document format (pdf) or if required in other sections of this Specification, native format in commonly used software such as Microsoft Excel or Word or Autodesk Revit or AutoCAD.

3. Coordinate preparation and processing of submittals with performance of construction activities.
   a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   b. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
1) Design Professional reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

4. Allow sufficient time for submittal review, including time for resubmittals. Time for review shall commence on Design Professional’s receipt of submittal. No extension of the contract time will be authorized because of failure to transmit submittals sufficiently in advance of the Work to permit processing, including resubmittals.
   a. Initial Review: Allow 5 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Design Professional will advise Contractor when a submittal being processed must be delayed for coordination.
   b. Resubmittal Review: Allow 5 days for review of each resubmittal.

5. For clarity purposes, product data, shop drawings and samples are further categorized as follows:
   a. Product data includes manufacturer’s standard catalogs, pamphlets and other printed materials, and includes but is not limited to the following:
      1) Product specifications
      2) Installation instructions
      3) Color charts
      4) Catalog cuts
      5) Rough-in diagrams and templates
      6) Wiring diagrams
      7) Performance curves
      8) Operational range diagrams
      9) Mill reports
   b. Shop drawings include drawings and schedules specifically prepared for the project, except for coordination drawings.
   c. Samples may include samples of such scale to allow delivery for review, as well as field samples or mock-ups of full-size physical examples erected on-site or elsewhere, to establish a true-scale standard by which the corresponding work will be judged or a standard for compliance testing.
   d. Informational quality assurance submittals include materials specifically prepared for the project, except drawings and schedules, and include but are not limited to the following:
      1) Design data and calculations
      2) Certifications of compliance or conformance
      3) Manufacturer’s instructions and field reports

B. Submittal Procedures – Product Data
1. A specific submittal shall not include products from multiple specification sections.
2. Place a permanent label such as a title sheet on each submittal for identification.
   a. Include the following information on the label:
      1) Project name
      2) Date
      3) Name and address of Contractor
      4) Name and address of supplier
      5) Submittal number or other unique identifier, including revision identifier. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
      6) Number and title of appropriate Specification Section
      7) Drawing number and detail references, as appropriate
3. Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

4. Make resubmittals in same form as initial submittal.
   a. Note date and content of revision in label and clearly indicate extent of revision.

5. Mark each copy of each submittal to show which products and options are applicable.

6. Include the following information, as applicable:
   a. Manufacturer’s written recommendations
   b. Manufacturer’s product specifications
   c. Manufacturer’s installation instructions
   d. Standard color charts
   e. Manufacturer’s catalog cuts
   f. Wiring diagrams showing factory-installed wiring and required field wiring
   g. Printed performance curves
   h. Operational range diagrams
   i. Mill reports
   j. Standard product operation and maintenance manuals
   k. Compliance with specified referenced standards
   l. Testing by recognized testing agency
   m. Application of testing agency labels and seals
   n. Notation of coordination requirements

7. Submit Product Data prior to submission of Samples.

C. Submittal Procedures – Shop Drawings

1. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   a. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      1) Dimensions
      2) Identification of products
      3) Fabrication and installation drawings
      4) Roughing-in and setting diagrams
      5) Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
      6) Shop-work manufacturing instructions
      7) Templates and patterns
      8) Schedules
      9) Design calculations
      10) Compliance with specified standards
      11) Notation of coordination requirements
      12) Notation of dimensions established by field measurement
      13) Relationship to adjoining construction clearly indicated
      14) Seal and signature of professional Design Professional if specified
      15) Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
D. Submittal Procedures - Samples

1. Submit by mail, Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   b. Identification: Attach label on unexposed side of Samples that includes the following:
      1) Generic description of Sample
      2) Product name and name of manufacturer
      3) Sample source
      4) Number and title of appropriate Specification Section
   c. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
      1) Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
      2) Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
   d. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
      1) Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Design Professional will return submittal with options selected.
   e. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
      1) Number of Samples: Submit three sets of Samples. Design Professional will retain two Sample sets; remainder will be returned.
         a) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
         b) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Submittal Procedure – Informational

1. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   a. Type of product. Include unique identifier for each product.
   b. Number and name of room or space.
   c. Location within room or space.
   d. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Design Professional will return two copies.
      1) Mark up and retain one returned copy as a Project Record Document.
2. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   a. Name, address, and telephone number of entity performing subcontract or supplying products.
   b. Number and title of related Specification Section(s) covered by subcontract.
   c. Drawing number and detail references, as appropriate, covered by subcontract.
   d. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Design Professional will return two copies.
      1) Mark up and retain one returned copy as a Project Record Document.
   e. Number of Copies: Submit three copies of LEED submittals, unless otherwise indicated.

F. Contractor’s Review
   1. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Design Professional.
   2. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

G. Design Professional’s Action
   1. Design Professional will not review submittals that do not bear Contractor's approval stamp and will return them without action.
   2. Design Professional will review each submittal, provide review comments on a separate document and/or make marks to indicate corrections or modifications required. Design Professional will stamp each submittal review document with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
      a. Record Document Submittals: Design Professional will review each submittal and will return it or will reject and return it if it does not comply with Contract Document requirements.
         1) Submittals of calculations for permanent parts of the structure will be reviewed by the Design Professional only for compliance with the specified design criteria. Each submittal will be stamped to indicate whether or not the Design Professional has made comments.
         2) Submittals of calculations of drawings for parts or assemblies which are not a permanent part of the structure will be reviewed by the Design Professional only for how the part of assembly interacts with the permanent structure. Each submittal will be stamped to indicate whether or not the Design Professional has made comments.
      b. Affix stamp, date and initials or signature certifying review of submittal, and with instructions for Contractor response, as follows:
         1) Approved as Submitted: That part of the Work covered by the Submittal may proceed without restriction from the Owner and Design Professional’s review, provided it complies with requirements of the Contract Documents.
         2) Approved as Noted – Resubmittal Not Required: That part of the Work covered by the Submittal may proceed without further restriction from the Owner and Design Professional’s review, provided it complies with notations and corrections made on the Submittal and requirements of the Contract Documents.
3) **Approved as Noted – Resubmit Noted Portions Only:** That part of the Work covered by the un-noted portion of the Submittal may proceed without restriction from the Owner and Design Professional’s review, provided it complies with requirements of the Contract Documents. The noted portion of the Submittal is restricted from proceeding and must be corrected as indicated and returned for further review by the Design Professional.

4) **Not Approved – Resubmittal Required:** That part of the Work covered by the Submittal is judged not in conformance with the design concept and/or information given in the Contract Documents and is restricted from proceeding until the Owner and Design Professional has reviewed the corrected Submittal.

5) **Reviewed Only/No Approval Action Required:** Design Professional did a cursory review and did not note a significant deviation from the Contract Documents.

6) **Not Required by Contract Documents:** Review of Submittal by the Owner and Design Professional not required. No action taken. Work shall proceed in compliance with requirements of Contract Documents.
   a) Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3. **Informational Submittals:** Design Professional will review each submittal and will not return it, or will return it if it does not comply with requirements. Design Professional will forward each submittal to appropriate party.

4. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

### 1.4 QUALITY ASSURANCE

**A. Source Limitations:** To the fullest extent possible, provide products of the same kind from a single source. Equipment of the same function shall be manufactured by the same entity, unless otherwise indicated.

**B. Compatibility of Options:** When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

**C. Labels and nameplates:** Except for required labels and operating data, do not attach or imprint manufacturers or producer's nameplates or trademarks on surfaces of products that will be exposed to view in occupied spaces or on the exterior.
   1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
   2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate nameplate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information:
      a. Name of product manufacturer.
      b. Model and serial numbers.
      c. Operating data such as capacity, speed and ratings.
   3. Protection: Labels and nameplates shall be protected from defacement and other damage during the remainder of the Work.

### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

**A.** Deliver, store and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

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

1.6 PRODUCT COMPLIANCE AND REQUIREMENTS

A. Provide products complete with accessories, trim, finish, safety guards, devices and other items needed for a complete installation and the intended use and effect. Where specified and available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents, including the Construction Contract Clauses, govern product selection. Requirements for product selection include the following:
1. Where the Specifications lists manufacturers' names or product designations, the Contractor may provide any product that complies with the requirements, subject to the following conditions:
   a. Manufacturers: Where a Specification paragraph or subparagraph titled "Manufacturers" lists manufacturers' names, provide a compliant product by one of the manufacturers named, or request a Substitution of another compliant product by another manufacturer.
   b. Available Manufacturers: Where a Specification paragraph or subparagraph titled "Available Manufacturers" lists manufacturers' names, provide a compliant product by one of the manufacturers named or by another manufacturer.
   c. Products: Where a Specification paragraph or subparagraph titled "Products" lists product designations, provide one of the products designated, or request a Substitution of another compliant product.
   d. Available Products: Where a Specification paragraph or subparagraph titled "Available Products" lists product designations, provide one of the products designated or another compliant product.
   e. Basis of Design: Where a Specification paragraph or subparagraph titled "Basis of Design" includes a product designation, provide the product designated, or request a Substitution of another compliant product by one of the other manufacturers named, if any, or by another manufacturer.
2. Descriptive Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
3. Performance Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.
4. Prescriptive Requirements: Where Specifications require products that are produced using specified ingredients and components, including specific requirements for mixing, fabricating, curing, finishing, testing and similar operations in the manufacturing process, provide products produced in accordance with the prescriptive requirements that otherwise comply with Contract requirements.

5. Codes, Standards and Regulations: Where Specifications require compliance with an imposed code, standard or regulation, select a product that complies with the codes, standards or regulations specified.

6. Visual Matching: Where Specifications require matching an established Sample, the Owner's Representative's decision will be final on whether a proposed product matches satisfactorily. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions concerning "substitutions" for selections of a matching product in another product category.

7. Visual Selection: Where specified product requirements include the phrase “as selected from manufacturer's standard colors, patterns, textures.” or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Owner's Representative will select the color, pattern and texture from the manufacturer's product line.

1.7 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work.

D. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment for the Work or part of the Work, the Owner reserves the right to refuse to accept the Work in behalf of the Government until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.8 PRODUCT LIABILITY INDEMNIFICATION

A. Contractor and Contractor’s suppliers will defend, indemnify and save harmless Owner, Design Professional and Design Professional's subconsultants against all expenses and damage arising from:

1. Actual or alleged infringement of any United States patent or copyright because of the sale or use of any article or material furnished by seller.

2. Nonconformity of the goods to the requirements of the Occupational Safety and Health Act of 1970 and the implementation regulations.

3. Failure of the goods to be manufactured in compliance with applicable law or governmental regulations.

4. Injury to person or property resulting from the defective or nonconforming condition of material or equipment purchased under this order to the extent the indemnitees are held liable.
B. Contractor shall include this indemnification in all agreements with their suppliers. If the Contractor fails to include the indemnification in all supplier agreements, the Contractor shall be solely responsible for the indemnification requirement.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 6000
SECTION 01 7600
PROTECTING INSTALLED CONSTRUCTION

PART 1 - GENERAL

1.1 PROTECTION OF ALL INSTALLED CONSTRUCTION

A. Any Component / System that is damaged, including but not limited to accidents or misuse resulting in scratches, dents, abrasions etc., shall be repaired back to “like new condition”, otherwise the same equipment shall be replaced with new equipment prior to “Final Acceptance” to the satisfaction of the Owner. This applies to all installed construction, including general, mechanical and electrical devices, equipment and systems, regardless of acceptance for use for and/or during Construction.

B. The Contractor shall only use permanent equipment as specified. Specific requests to use permanent equipment other than what is specified must first be approved by the Owner prior to such use. This includes the use of devices, equipment and systems, such as elevators or HVAC equipment, during any phase of construction prior to final acceptance.

C. During the construction process, Contractor shall ensure that all installed material, devices, equipment and systems are not exposed to construction environments that are likely to hinder their proper operation/performance or shorten their useful life regardless of desire by Contractor for use prior to final acceptance.

D. All equipment warranties shall be adjusted and/or extended so as to not impact the normal minimum expected warranty duration as expressed or implied within this Specification and without additional cost to the Owner.

E. Protect all components containing fluids from freezing. Ensure all related safeties and necessary controls are active and functioning. Verify with Owner prior to use. Approval for use during construction will not constitute final acceptance of components or systems.

F. Under no circumstance shall any system in whole or part be allowed to operate beyond the design parameters of this project or the respective manufacturer’s limits.

1.2 USE OF EXISTING ELEVATORS FOR CONSTRUCTION PURPOSES

A. The use of an existing elevator during construction shall be strictly prohibited. Any deviation from this policy shall only be permitted by means of an approved variance for the project.

1.3 FINISHES AND FURNISHINGS

A. Each Contractor shall ensure that all installed finishes and furnishings are not exposed to construction environments that are likely to mar their appearance or shorten their useful life. For example, carpet and other floor finish surfaces shall not be installed at a stage in the Project, which will result in them being subjected to excessive soiling, spotting, staining, scratching, abrasion, or wetting.

B. Contractor shall not use any installed furniture item as a bench, ladder or support for work they may be completing in any Owner space. If such furnishings impede or block assigned work, contractor shall notify Owner for adjustment or removal of said furnishings.

C. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.
   1. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
2. Protect finished floors and stairways from dirt, wear and damage, traffic, movement of heavy objects, and storage.
3. Secure heavy sheet goods or similar protective materials in place in area subject to foot traffic.
4. Lay planking or similar rigid materials in place in areas subject to movement of heavy objects or where storage of products will occur.
5. Cover walls and floors of elevator cabs and jambs of cab doors when elevators are to be used by construction personnel.
6. Prohibit traffic and storage on waterproofed and roofed surfaces, and landscaped areas.

D. When an activity is mandatory, obtain recommendations for protection of surfaces from manufacturer. Install protection and remove on completion of activity. Restrict use of adjacent unprotected areas.

E. Damage to work caused by failure to provide protection shall be removed and replaced with new work at no additional expense to Owner.

F. Take special precautions during winter construction against damage to materials stored and work installed in freezing weather. Provide coverings for materials subject to damage by elements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 7600
SECTION 01 7700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for Contract closeout including, but not limited to, the following:
   1. Substantial Completion
   2. Final Acceptance
   3. Inspection procedures.
   4. Final cleaning.

B. Closeout requirements for specific construction activities are included in the individual Specification Sections.

C. Substantial Completion is defined as that state when the Contractor has complied with the Contract requirements, except for minor deviations, and the project is sufficiently complete and capable of being occupied and used by the Owner for the intended purpose.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for Substantial Completion, complete the following.
   1. Provide supporting documentation for completion as indicated elsewhere in the Contract Documents and a statement showing an accounting of changes to the Contract Sum.
   2. Submit a written notice that the Work, or a designated portion thereof, is substantially complete.
   3. Submit a list to the Owner, of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
   4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Submit all documents required by Section 01 7800 Closeout Submittals including but not limited to operation and maintenance manuals, final project photographs, damage or settlement survey, and utility lines survey.
   6. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner user personnel of changeover in security provisions.
   7. Complete startup testing of systems and instruction of the Owner operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.

B. Inspection Procedures: On receipt of a request for inspection, the Owner will either proceed with inspection or advise the Contractor of unfilled requirements. The Owner will notify the Contractor of Substantial Completion following the inspection or advise the Contractor of construction that must be completed or corrected before Substantial Completion.
   1. The Owner will repeat the inspection when requested and when assured that the Work is substantially complete.
   2. Results of the completed inspection will form the basis of the requirements for Final Acceptance.
1.3 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting re-inspection for Final Acceptance, complete the following:

1. Submit final payment request with releases and supporting documentation not previously submitted and accepted.
2. Submit an updated final statement, accounting for final additional changes to the Contract price.
3. Submit a certified copy of the previous Substantial Completion inspection list of items to be completed or corrected. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Contractor.
4. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
5. Submit record documents and similar final record information.
6. Deliver tools, spare parts, extra stock and similar items.
7. Complete final clean-up requirements including touch-up painting of marred surfaces.
8. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date when the Owner took possession of and assumed responsibility for corresponding elements of the work.

B. Re-inspection Procedure: The Owner will re-inspect the Work upon receipt of notice from the Contractor that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Owner.

1. Upon completion of re-inspection, the Owner will notify the Contractor of Final Acceptance or will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled and are required for Final Acceptance.
2. If necessary, re-inspection will be repeated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the Owner’s personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer’s representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following:

1. Maintenance manuals
2. Record documents
3. Spare parts and materials
4. Tools
5. Identification systems
6. Control sequences
7. Hazards
8. Cleaning
9. Warranties and bonds
10. Maintenance agreements and similar continuing commitments
B. As part of instruction for operating equipment, demonstrate the following procedures:
   1. Startup
   2. Shutdown
   3. Emergency operations
   4. Noise and vibration adjustments
   5. Safety procedures
   6. Economy and efficiency adjustments
   7. Effective energy utilization

3.2 FINAL CLEANING

A. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial cleaning and maintenance program. Comply with manufacturer's instructions.
   1. Complete the following cleaning operations before requesting inspection for Final Acceptance.
      a. Remove labels that are not permanent labels.
      b. Clean transparent materials, including mirrors and glass in doors and windows. Removing glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
      c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete floors broom clean.
      d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
      e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean, and remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.

B. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests.

C. Removal of Protection: Remove temporary protection and facilities installed for the protection of the Work during construction.

D. Compliance: Comply with the regulations of authorities having jurisdiction and with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of it lawfully.

E. Remaining Materials: Extra materials of value, that remain after completion of associated work, become Government property. Dispose of these materials as directed by the Owner's Representative.

END OF SECTION 01 7700
SECTION 01 7800

CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes administrative and procedural requirements for the submittal of operation and maintenance manuals, record documents, material and finishes manual and warranties.

B. Additional Requirements: Refer to the individual Specification sections for specific requirements related to the submittals referenced in this Section.

1.2 SUBMITTALS

A. Submittal Schedule: Comply with the following schedule for submitting operation and maintenance manuals:
   1. Prior to substantial completion, submit three copies of drafts of the closeout documents. Each draft shall be contained on a separate external portable hard drive as specified herein.
   2. The Owner will return the three hard drives containing the drafts with comments.
   3. Make corrections or modifications to comply with the Owner's comments.
   4. Revise and resubmit to the Owner prior to request for final payment, the three external portable hard drives with the revised closeout documents.

B. Submittal Format: Submit all project closeout documents electronically using Adobe Acrobat portable document format (pdf file) or native format in commonly used software such as Microsoft Word and Excel or Autodesk Revit.
   1. Each set of closeout documents shall be submitted on a separate portable external hard drive as manufactured by Western Digital or Seagate. Size shall be as appropriate for the amount of documents but not less than one terabyte.
   2. Index the documents using the Acrobat bookmark feature.

1.3 OPERATION AND MAINTENANCE MANUAL

A. Provide manuals in accordance with the requirements of the individual Specification section.

B. As a minimum, the following information shall be provided for each system and related equipment:
   1. Operating characteristics with limiting conditions
   2. Performance curves and engineering data
   3. As-installed control diagrams
   4. As-installed color coding charts and diagrams
   5. Parts nomenclature and numbers
   6. Operating procedures and start-up procedures
   7. Manufacturer's instructions for maintenance, and service and care
   8. Shop drawings
   9. Spare parts
   10. Warranties
   11. Troubleshooting procedures
   12. Safety requirements, operating cautions
   13. Overall system diagrams for use by operations and maintenance personnel
1.4 RECORD DRAWINGS

A. Use a set of prints or electronic files of the Contract Drawings for maintaining a record of the actual installation.

B. Markup Procedure: During construction, maintain a set of Contract Drawings for Project record document purposes.
   1. Mark these Drawings to show the actual installation where the installation varies from the installation shown on the Contract Drawings. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:
      a. Dimensional changes to the Drawings
      b. Revisions to details shown on the Drawings
      c. Depths of foundations below the first floor
      d. Locations and depths of underground utilities
      e. Revisions to routing of piping and conduits
      f. Revisions to electrical circuitry
      g. Actual equipment locations
      h. Duct size and routing
      i. Locations of concealed internal utilities
      j. Changes made by Change Order or Construction Change Directives
      k. Changes made following the Design Professional’s written orders
      l. Details not on original Contract Drawings
   3. Mark record sets with red color. Use other colors to distinguish between changes for different categories of the Work at the same location.
   4. Mark important additional information that was either shown schematically or omitted from Contract Drawings.
   5. Note alternate numbers, Change Order numbers, and similar identifications.

C. The Contractor may choose to submit contractor prepared fabrication drawings as a record of the actual installation.
   1. Notes and information specific to the fabrication shall be removed from the drawings prior to submittal as record drawings.
   2. As a minimum, the contractor’s prepared drawings shall show the same level of information as on the Contract Drawings including equipment details.

1.5 MATERIAL AND FINISHES MAINTENANCE MANUALS

A. Provide one section for architectural products, including applied materials and finishes. Provide a second section for products designed for moisture protection and products exposed to the weather.

B. Architectural Products: Provide manufacturer’s data and instructions for the care and maintenance of architectural products, including applied materials and finishes.
   1. Manufacturer’s Data: Provide complete information on architectural products, including the following, as applicable:
      a. Manufacturer’s catalog number
      b. Size
      c. Material composition
      d. Color
      e. Texture
f. Reordering information for custom manufactured products

2. Care and Maintenance Instructions: Provide care and maintenance information, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information about cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.

C. Moisture Protection and Products Exposed to the Weather: Provide complete manufacturer's data with instructions for the inspection, maintenance and repair of products exposed to the weather or designed for moisture-protection purposes.

1. Manufacturer's Data: Provide detailed manufacturer's information, including the following, as applicable.
   a. Applicable standards
   b. Chemical composition
   c. Installation details
   d. Inspection procedures
   e. Maintenance information
   f. Repair procedures

1.6 WARRANTIES

A. Submit guarantees/warranties in accordance with the requirements of the individual Specification section.

B. Guarantees from subcontractors and suppliers shall not limit Contractor's warranties and guarantees to the Owner. Whenever possible, Contractor shall cause warranties of subcontractors and suppliers to be made directly to the Owner. If such warranties are made to Contractor, Contractor shall assign such warranties to the Owner prior to final payment.

C. Compile the guarantees/warranties specified in respective sections of the Specification.

D. Review documents for compliance with the Contract Documents. Verify that documents are in proper form, contain full information, and are notarized.

E. For each guarantee/warranty include the following:
   1. Name, address, telephone number, and responsible principal of material supplier, manufacturer, and subcontractor as appropriate.
   2. Beginning date and duration
   3. Proper procedure in case of failure
   4. Instances that might affect guarantees/warranty
   5. Obtain guarantees/warranties, executed by responsible Subcontractors, suppliers, and manufacturers
   6. Except for items put into use with Owner's permission, leave date of beginning of time of guarantee/warranty until the Date of Final Completion is determined.

F. Where there is no specific guarantee/warranty specified, but one is typically provided by the product manufacturer for the product specified, provide Owner with the manufacturer's standard guarantee/warranty.

G. For items of Work when acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing the date of Final Completion as the beginning of the warranty period.
PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 7800
SECTION 26 0000
GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION

A. Intent of drawings and Specifications is to obtain complete systems tested, adjusted, and ready for operation.

B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 26 Contract Documents shall have the following meanings:
   1. "Provide" or "provided" shall mean "furnish and install".
   2. "Furnish" or "furnished" does not include installation.
   3. "Install" or "installed" does not include furnishing.

C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with other trades.

E. Coordinate all construction schedules, closures, and working area durations with DCS Project Manager, City of Phoenix Business and Properties (602-273-3337), and Landside Operations (602-273-2765) to minimize impact to airport daily operations.

F. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for dimensions.

G. Where architectural features govern location of work, refer to Architectural Drawings.

H. Perform work in "neat and workmanlike" manner as defined in ANSI/NECA 1, Standard Practices for Good Workmanship in Electrical Contracting.

1.3 RELATED WORK

A. Utility Services:
   1. Determine utility connection requirements and include in Base Bid all costs to Owner for utility service.
   2. Include costs for temporary service, temporary routing of service or other requirements of a temporary nature associated with utility service.

B. Temporary Services:
   1. Division 01 - Temporary Facilities and Controls.
C. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Owner. Obtain written permission before work is started.
   2. When interruption of services is required, Architect, Owner and other concerned parties shall be notified and shall determine a time.

D. Demolition:
   1. Division 26 0010 - Selective Demolition
   2. Perform required demolition to accomplish new work.
      a. Remove abandoned wiring to source of supply.
      b. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
      c. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
      d. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
      e. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
   3. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other Contractors.
   4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
   5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
   6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
   7. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such work.

E. Cleaning and Repair
   1. Clean and repair existing materials and equipment that remain or are to be reused.
   2. Panelboards.
      a. Clean exposed surfaces and check tightness of electrical connections.
      b. Replace damaged circuit breakers and provide closure plates for vacant positions.
      c. Provide typed circuit directory showing revised circuiting arrangement.

F. Painting:
   1. Furnish equipment with factory-applied finish coats or paint equipment unless specified otherwise.
   2. Furnish equipment with factory applied prime finish unless otherwise specified.
   3. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Architect.
   4. Furnish one can of touch up paint for each final factory-applied finish coat of product.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and local authorities and utility companies, in force at time of execution of Contract shall become part of this specification.
1.5 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:
   1. AEIC  Association of Edison Illuminating Companies
   2. ANSI  American National Standards Institute
   3. ASTM  American Society for Testing and Materials
   4. BICSI  Building Industry Consulting Services International
   5. EIA   Electronic Industries Association
   6. FIPS  Federal Information Processing Standards
   7. FCC   Federal Communications Commission
   8. ICEA  Insulated Cable Engineers Association
   9. IEEE  Institute of Electrical & Electronics Engineers
  10. IESNA Illuminating Engineering Society of North America
  11. NEC  National Electrical Code
  12. NECA National Electrical Contractors Association
  13. NEMA National Electrical Manufacturers Association
  14. NESC National Electrical Safety Code
  15. NETA National Electrical Testing Association
  16. NFPA National Fire Protection Association
  17. NIST National Institute of Standards & Technology
  18. OSHA Occupational Safety and Health Administration
  19. TIA Telecommunications Industries Association
  20. UL Underwriters Laboratories, Inc.

B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.6 LISTING

A. Install materials bearing UL label or UL listing, unless UL label or listing is not available for that type of material.

B. Other nationally recognized testing agencies, acceptable to AHJ, are approved.

1.7 ENCLOSURES

A. Typical NEMA Enclosures and Usage
   1. NEMA 1 - Indoors. Falling dirt.
   2. NEMA 2 - Indoors. Falling dirt. Falling liquids. Light splashing.
   3. NEMA 3 - Outdoors. Sleet, snow, rain. Windblown dust.
   4. NEMA 3X - Same as NEMA 3 plus corrosion resistant.
   5. NEMA 3S - Same as NEMA 3 plus mechanism operable when ice covered.
   6. NEMA 3SX - Same as NEMA 3S plus corrosion resistant.
   7. NEMA 3R - Outdoors. Rain, snow, sleet.
   8. NEMA 3RX - Same as NEMA 3R plus corrosion resistant.
   9. NEMA 4 - Indoors. Falling dirt. Falling and light splashing liquids. Flying dust, lint and fibers.
      Hose down.
  10. NEMA 4X - Same as NEMA 4 - Indoors plus corrosion resistant.
  11. NEMA 4 - Outdoors. Rain, sleet, snow. Wind blown dust. Hose down.
12. NEMA 4X - Same as NEMA 4 - Outdoors plus corrosion resistant.
15. NEMA 6P - Same as NEMA 6 - Indoors plus corrosion resistant. Prolonged submersion.
17. NEMA 6P - Same as NEMA 6 - Outdoors plus corrosion resistant. Prolonged Submersion.
18. NEMA 7 - Indoors. Class I, Division 1 or 2, Groups A, B, C or D. (Flammable gas).
19. NEMA 9 - Indoors. Class II, Division 1 or 2. Groups E, R, or G. (Combustible dust).
20. NEMA 12 - Indoors. Falling Dirt. Falling liquids. Flying dust, lint and fibers. Oil or coolant seepage.
21. NEMA 13 - Same as NEMA 12 plus oil or coolant spraying or splashing.

1.8 SUBMITTALS

A. Shop Drawings (Product Data):
1. Refer to Division 01 - Submittal Procedures.
2. Note that for satisfying submittal requirements for Division 26, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, the expression "Shop Drawings" is generally used throughout Specification.
3. Submit shop drawings for equipment and systems as requested in respective specification sections. Submittals which are not requested may not be reviewed.
4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.
5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
6. When manufacturer’s reference numbers are different from those specified, provide correct cross-reference number for each item. Clearly mark and note submittal accordingly.
7. Submit complete record of required components when luminaires, equipment and items specified include accessories, parts and additional items under one designation.
8. Include wiring diagrams for electrically powered or controlled equipment.
9. Submit electrical equipment room layouts drawn to scale, including equipment, raceways, accessories and required working clearances. Submit electrical equipment room layouts concurrently with electrical distribution equipment submittals.
10. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
11. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
12. Submittals that are not complete, not permanent, or not properly checked by Contractor, will be returned without review.
13. "Coordination Drawings", which are normally prepared by Contractor to coordinate work among various trades and to facilitate installation, shall not be submitted for Division 26 work unless specifically requested in technical sections. These types of drawings typically include dimensioned piping, ductwork or electrical raceway layouts.
14. Unless specifically requested in Division 26 technical sections, submittals of coordination drawings will be returned without review.

B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.
C. Operation and Maintenance Manuals:
   1. Upon completion of work but before final acceptance of system, submit to Engineer for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If “one copy” is larger than 2” thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
   2. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
   3. Manuals shall include the following:
      a. Copies of shop drawings
      b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
      c. CD ROM's of O&M data with exploded parts lists where available
      d. Phone numbers and addresses of local parts suppliers and service companies
      e. Internet/WEB page addresses where applicable
      f. Wiring diagrams
      g. Start up and shut down procedure
      h. Factory and field test records
      i. Additional information, diagrams or explanations as designated under respective equipment or systems specification section
   4. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
   5. Furnish O&M manuals and instructions to Owner prior to request for final payment.

D. Record Documents:
   1. Refer to General Conditions of Contract and Division 01 - Project Record Documents. Prepare complete set of record drawings in accordance with Division 01.
   2. Use designated set of prints of Contract Documents as prepared by Engineer to mark-up for record drawing purposes.

1.9 JOB CONDITIONS

A. Building Access:
   1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Coordination:
   1. Equipment provided under other Divisions of these specifications.
      a. Motors
      b. Electrically powered equipment
      c. Electrically controlled equipment
      d. Starters, where specified
      e. Variable frequency drives, where specified
      f. Control devices, where specified
      g. Temperature Control wiring
   2. Provide the following devices required for control of motors or electrical equipment, unless noted otherwise:
      a. Starters
      b. Disconnect devices
      c. Control devices:
         1) Pushbuttons
2) Pilot lights
3) Contacts
d. Conduit, boxes and wiring for Power wiring
e. Conduit, boxes and wiring for Control wiring, except temperature control wiring
3. Connect and wire equipment complete and ready to operate according to wiring diagrams furnished by various trades.
4. Wire starters or other similar control devices furnished by others.
5. This contractor's drawings and/or specifications show number and hp rating of motors furnished by others, together with their actuating devices. Should any change in size, hp rating, voltage, or means of control be made to any motor or other electrical equipment after Contracts are awarded, Contractor responsible for change shall immediately notify this Contractor. Additional costs due to these changes shall be responsibility of Contractor initiating change.
6. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain tight, explosion proof, dust tight, or any other special type as required.)
7. Comply with local utility motor starting requirements and provide starters for motors furnished by others as specified herein or under various trade sections of those specifications.

C. Cutting and Patching:
1. Refer to General Conditions of the Contract and Division 01 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide materials required for patching unless otherwise noted.
4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.
5. Where alterations disturb lawns, paving, walks, etc., replace, repair or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.

D. Housekeeping and Cleanup:
1. Refer to Division 01 - Closeout Procedures.
2. As work progresses or as directed by Architect, periodically remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.

1.10 WARRANTY

A. Refer to Division 01 for general warranty requirements.
B. Refer to technical sections for warranty requirement for each system.
  1. Where no warranty requirements are called out, warrant for 10 year after acceptance by Owner equipment, materials, and workmanship to be free from defect.
C. Repair, replace, or alter systems or parts of systems found defective at no extra cost to Owner.
D. In any case, wherein fulfilling requirements of any guarantee, if this contractor disturbs any work guaranteed under another contract, this contractor shall restore such disturbed work to condition satisfactory to Architect and guarantee such restored work to same extent as it was guaranteed under such other contract.
E. Warranty shall include labor, material, and travel time.
PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTIONS
   A. Refer to Division 01 - Product Requirements.

PART 3 - EXECUTION

3.1 GENERAL
   A. Verify elevations and dimensions prior to installation of materials.

3.2 DELIVERY, STORAGE, AND HANDLING
   A. Deliver products to the site under provisions of Division 01.
   B. Store and protect products under provisions of Division 01.
   C. Store in clean, dry space.
   D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.
   E. Handle in accordance with manufacturer’s written instructions.
   F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided.
   G. Provide supplemental heat if required to prevent moisture contamination.

3.3 EQUIPMENT ACCESS
   A. Install raceways, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocate raceways or accessories to provide maintenance access at no additional cost to Owner.
   B. Install equipment with sufficient maintenance space for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other future or installed equipment.

3.4 EQUIPMENT SUPPORTS
   A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.
   B. Provide steel shell with plug type concrete anchors for attaching equipment to concrete. Plastic, rawhide or anchors using lead are not allowed.
   C. Do not support equipment or luminaires from metal roof decking.

3.5 SUPPORT PROTECTION
   A. In occupied areas, mechanical and electrical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.
B. Provide minimum 1/2” thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment, including bus duct, cable tray, pull boxes and electrical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

C. Protect threaded rods or bolts at supporting elements as described above. Trim threaded rods or bolts such that they do not extend beyond supporting element.

3.6 LEAD SHIELDING

A. Wherever installation of this contractor's equipment destroys radiological integrity of wall, floor, or ceiling, this contractor shall be responsible to provide suitable lead shielding to restore that integrity. Coordinate these requirements with General Contractor.

3.7 START-UP

A. Systems and equipment shall be started, tested, adjusted, and turned over to Owner ready for operation. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.

B. Follow manufacturer's pre-start-up checkout, start-up, trouble shooting and adjustment procedures.

C. Contractor shall provide services of technician/mechanic knowledgeable in start-up and checkout of types of systems and equipment on project.

D. Provide start-up services by manufacturer's representative where specified or where Contractor does not have qualified personnel.

E. Coordinate start-up with all trades.

3.8 CLEANING

A. Clean systems after installation is complete.

B. Vacuum debris from panelboards, switchboards, motor starter and disconnect switch enclosures, junction boxes and pull boxes two weeks before energization and again prior to completion.

C. Where louvers are provided in switchgear or transformer enclosures, vacuum louvers free of dust and dirt.

D. Clean luminaire lenses and lamps at time of installation and clean lens exteriors just prior to final inspection.

E. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

END OF SECTION 26 0000
PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Selective demolition including:
      a. Non-destructive removal of materials and equipment for reuse or salvage as indicated.
      b. Dismantling electrical materials and equipment made obsolete by these installations.

B. Related Sections include the following:
   1. Section 26 0000 – General Electrical Requirements.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 – General Requirements as apply to this section.

1.3 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, duct, and noise from being transmitted to adjacent areas. Remove protective and barriers after demolition operations are complete.
   2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted or relocated, install temporary and/or permanent services for affected areas.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials and equipment for patching and extending work shall be as specified in individual sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which the work is to be installed in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies before distributing existing installation.

D. Beginning of demolition means acceptance of existing conditions.
3.2 PREPARATION

A. General:
   1. Disconnect electrical systems in walls, floors, and ceiling scheduled for removal.
   2. Coordinate utility outages with the Utility Company.
   3. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operation.

B. Existing Electrical Service: Maintain existing system in service until new systems are complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner at least two weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF ELECTRICAL WORK

A. General: Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
   1. Raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations.

E. The Contractor shall note that the existing facility will remain in service during construction. Construction must be arranged and coordinated to enable completion of the work in such manner as to cause the least possible interference with these operations. All work required in the building shall be performed in a manner and time acceptable. Outages and other work rendering existing equipment inoperative shall be held to a minimum. Prior arrangements for each such interruption shall be acceptable as to time and duration.

F. The Contractor shall be responsible for the work of other trades as may be necessary for facilitate the installation of electrical work in the existing building.

G. Any existing circuits or equipment not shown on the drawings and which are logically expected to be continued in service and which may be interrupted or disturbed during construction shall be reconnected in an approved manner. In addition, any existing circuits or equipment which may require relocation or rerouting as a result of the work of this branch and shall be done by the Contractor with no additional compensation.

H. Remove, relocate, and extend existing installations to accommodate new construction.

I. Remove abandoned wiring to source of supply unless specifically noted otherwise.

J. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
K. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if the conduit servicing them is abandoned and removed. Provide blank covers for abandoned outlets which are not removed. Any existing equipment not shown on drawings and which are logically expected to be removed shall be removed with no additional compensation.

L. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

M. Repair adjacent construction and finishes damaged during demolition and extension work.

N. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

O. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 GENERAL DISPOSAL

A. Dispose of equipment that is removed unless specifically indicated on the drawings.

B. Raceway, conductors, boxes, cabinets, and supporting devices shall become the property of the Contractor and shall be removed from the site and disposed of by the Contractor.

C. The Contractor shall tour demolition areas to determine the status of all other equipment to be removed during demolition. All equipment that is to be salvaged for reuse by the owner shall be removed by the Contractor and transported to designated storage area on the site. Shall be responsible for removal of salvaged equipment from the storage area.

D. Disposal of lamp and PCB ballast may be provided by SD Meyers, 180 South Avenue, Tallmadge, Ohio 44278.

E. Lighting Fixture Ballast Disposal
   1. The Contractor shall inspect all ballasts in all light fixtures removed as part of this project and take the actions described below.
   2. All ballasts labeled as “NON PCB’S” shall be handled as described in other sections of these specifications which describe demolition or salvage materials handling. If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.
   3. All PCB ballasts shall have the wires clipped off and the ballasts placed in US DOT approved type 17C or type 17H barrels and placed in storage in a location within the building as designated. The Contractor shall provide in typewritten form, a total count of these ballasts and where they are stored.
   4. These ballasts are to be removed from the work site by the Contractor.
   5. The Contractor shall provide approved PCB absorbent materials to be stored immediately adjacent to the barrel storage area. Do not place loose absorbent material in the barrels.
6. When the ballast demolition is completed and all PCB ballasts are placed in barrels, the Contractor shall notify in writing that demolition is complete. The Contractor shall also provide the name, address and telephone number of at least (1) additional licensed ballast disposal providers. Contractor is responsible for arrangement of pick up and disposal of the PCB ballasts. The cost of disposal of ballast shall be included in the contractors bid.

F. Lighting Fixture Lamp Disposal
1. The Contractor shall be responsible for the proper removal and recycling of all existing lamps being removed from service in accordance with EPA and State requirements. Lamps shall not be disposed of in any way except as described herein.
2. The Contractor shall be responsible for arranging for recycling of lamps by a licensed waste lamp and bulb recycler. The cost for recycling of removed lamps shall be included in the Contractor’s bid.
3. The Contractor shall carefully package removed lamps to prevent breakage. The Contractor shall store waste lamps in a secure area, either in the container that the lamps are shipped in or in other ways so as to eliminate breakage. Both the lamp storage area and individual containers should be labeled as hazardous waste. Store lamps in covered containers to prevent lamps from being broken as a result of other debris being placed on top of them.

3.5 ALTERATIONS
A. The contractor shall be responsible for work of other trades to facilitate installation of electrical work in the existing building.
B. Work required by Electrical Contractor which is normally performed by other trades shall be done under direction and at the expense of Electrical Contractor or shall be coordinated.

3.6 CLEANING AND REPAIR
A. General: Clean and repair existing materials and equipment which remain or are to be reused.
B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean exterior and interior surfaces, rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

END OF SECTION 26 0010
PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0529 - Hangers and Supports for Electrical Systems
   B. Section 26 0533 - Surface Metallic Raceway System

1.2 REFERENCE
   A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION
   A. Section includes conductors and cables rated 600 V and less, connectors, splices, and terminations rated 600 V and less, sleeves and sleeve seals for cables.
   B. Conductor and conduit sizes in these contract documents are based on copper wire, and only copper wire shall be used.

1.4 REFERENCE STANDARDS
   D. NEMA WC 5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-61-402).
   E. NEMA WC 70 Non-Shielded Power Cable 2000 V or less for the Distribution of Electrical Energy (ICEA S-95-668).
   F. NFPA 70 National Electrical Code.
   G. UL 44 Thermoset-Insulated Wires and Cables.
   H. UL 83 Thermoplastic-Insulated Wires and Cables.
   I. UL 486A-486B Wire Connectors.
   J. UL 486C Splicing Wire Connectors.
   K. UL 486D Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
   L. UL 486E Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
M. UL 1569 Standard for Metal-Clad Cables.

1.5 SUBMITTALS

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

B. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of components and circuits.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

B. Wire and cable boxes and reels shall bear the date of manufacture.
   1. Date of manufacture shall not precede contract date by more than one year.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.8 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Alcan Products Corporation; Alcan Cable Division

B. General Cable Corporation

C. Cerrowire

D. Southwire Company

2.2 DESCRIPTION

A. NEMA WC 70; single copper conductor insulated wire; 600 V rated insulation; 90°C maximum operating temperature for dry and wet or damp locations.
   1. Thermoplastic-insulated wires and cables: NEMA WC 5, UL 83; Type THWN.
   2. Thermoset-insulated wires and cables: NEMA WC 3, UL 44; Type XHHW, XHHW-2 and SO on fixture whip.
2.3 REMOTE CONTROL AND SIGNAL CIRCUITS

A. Class 1
   1. Copper conductor, single insulated wire.
   2. Insulation type THHN or THHW rated 90°C, 600 V insulation class.
   3. Type XHHW for ambient temperature less than 32°F.
   4. UL 83 listed, ASTM B 1 for solid conductors; ASTM B 8 for stranded conductors.

B. Classes 2 and 3
   1. Copper conductor, multiple twisted conductors covered with an overall non-metallic jacket unless otherwise noted.
   2. Insulation type XLE, rated 105°C, 300 V insulation class.
   3. UL listed for use in space in which circuits will be installed.

2.4 CONNECTORS, SPLICES, AND TERMINALS

A. Manufacturers:
   1. AFC Cable Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division
   5. Tyco Electronics Corp.

B. Description: UL 486A-486B, UL 486C, UL 486D, UL 486E; factory-fabricated connectors, splices, and terminals of size, ampacity rating, material, type, and class for application and service indicated.

2.5 TERMINATIONS

A. Compression set, bolted or screw type lug, or direct to bolted or screw type terminal.

2.6 PLASTIC CABLE TIES

A. Nylon or approved; locking type; metallic ties not permitted.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

A. Install conductors in a raceway system, unless otherwise specified or indicated.

B. Install conductors only after:
   1. Building interior is enclosed and weather tight
   2. Mechanical work likely to damage conductors has been completed
   3. Raceway installation is complete and supported

C. Pull conductors into raceway at same time.

D. Neatly train and lace conductors inside boxes, equipment, and panelboards.

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

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

H. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible. Protect exposed cables from damage.

I. Support cables above accessible ceiling using plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

J. Support cables and conductors in vertical raceways per requirements in Section 26 0529 - Hangers and Supports for Electrical Systems.

K. Wiring at Outlets: Install conductor at each outlet, with minimum 6” of slack.

L. Limit conduit fill to a maximum of 9 current-carrying conductors.

M. Install stranded conductors where conductors terminate in crimp type lugs. Do not place bare stranded conductors directly under screws.

3.2 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Stranded for #12 AWG and larger.

B. Branch Circuits: Copper. Stranded for #12 AWG and larger.

C. Minimum conductor sizes shall be as follows:
   1. #12 AWG – Branch circuits of any kind.
   2. #14 AWG – Fire alarm system.
   3. #16 AWG – Remote control and signal systems.

D. Branch wiring length limitations:
   1. 208Y/120 V circuits over 100’ in length: Increase wire size one size for each 100’ of length. Increase conduit size as required.
   2. 480Y/277 V circuits over 150’ in length: Increase wire size one size for each 150’ of length. Increase conduit size as required.

3.3 CONDUCTOR INSULATIONS AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHW or THWN rated 75°C for wet locations, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHW or THWN, rated 75°C for wet locations, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW, rated 75°C for wet locations, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawl Spaces: Type THHN, rated 90°C for dry and wet or damp locations, single conductors in raceway.
E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN, rated 90°C for dry and wet or damp locations, single conductors in raceway.

F. Branch Circuits Single Conductors in Raceway: 90°C rated conductors sized at 75°C rating for connection to equipment and devices.

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

3.4 REMOTE CONTROL AND SIGNAL CIRCUITS

A. Sizing – #16 AWG minimum.

B. Installation:
   1. Install cables in cable tray and cable rings.
   2. Provide protection for exposed cables where subject to damage.
   3. Support cables above accessible ceilings; do not rest on ceiling tiles.
   4. Use suitable cable fittings and connectors.

3.5 CONNECTORS, SPLICES, AND TERMINALS

A. Connectors:
   1. Except where equipment is furnished with bolted or screw type lug, use compression set pressure connectors with insulating covers. Use compression tools and die compatible with connectors being installed.
   2. Use bolt or compression-set type with application of insulating tape, pre-stretched or heat-shrinkable insulating tubing for splices and taps of #8 AWG conductors and larger. Install with hydraulic compression tool.
   3. Use pre-insulated “twist-on” connectors with integral spring for splices and taps of #10 AWG conductors and smaller.
   4. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A-486B.
   5. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only.
   6. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

B. Splices:
   1. Splice wires and cable only in accessible locations such as within junction boxes.
   2. Make splices to carry full capacity of conductors with no perceptible temperature rise.
   3. Make below-grade splices in manholes and handholes watertight with pre-stretched or heat-shrinkable insulating tubing, or resin-filled insulator.
   4. Use electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half-lapped layers of plastic electrical tape, for joints, taps, and splices of #1 AWG conductors and larger.
   5. Plastic snap-on splice insulators are not allowed.
   6. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   7. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
C. Terminals:
   1. Insulate ends of spare conductors with electrical tape and identify spare circuit number where appropriate.
   2. Eye type crimped terminal for removable screw type terminal. Forked torque terminal when screw terminal cannot be removed.
   3. Train wires to eliminate fanning of stands, crimp with proper tool and die.
   4. Torque screw termination per manufacturer’s recommended values.

3.6 CABLE TIES

A. Neatly bundle conductors and cables together for support. Size cable ties sufficiently to accommodate the multiple cables being supported.

3.7 FIELD QUALITY CONTROL

A. Interpret test results in writing and submit to Engineer.

B. Replace conductors and cables that are found defective, at no expense to Owner.

END OF SECTION 26 0519
PART 1 - GENERAL

1.1 RELATED WORK

   A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION

   A. Section includes methods and materials for grounding systems and equipment, as required by State Codes, NFPA 70, applicable portions of other NFPA codes, as indicated herein.

   B. Maximum resistance to ground shall be less than 5 ohms.

1.3 REFERENCE STANDARDS

   A. ASTM B 3 Specification for Soft or Annealed Copper Wire

   B. ASTM B 8 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft

   C. ASTM B 33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

   D. IEEE C2 National Electrical Safety Code (ANSI)

   E. IEEE 857 Standard for Qualifying Permanent Connections Used in Substation Grounding

   F. NETA MTS Maintenance Testing Specifications

   G. NFPA 70 National Electrical Code

   H. NFPA 70B Recommended Practice for Electrical Equipment Maintenance

   I. UL 467 Grounding and Bonding Equipment

1.4 QUALITY ASSURANCE

   A. Regulatory Requirements:

      1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.

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

1.5 DELIVERY, STORAGE, AND HANDLING

   A. Store products in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.6 WARRANTY

   A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.
B. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction, insulation color: green.

B. Bare Copper Conductors:

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for #6 AWG and larger, unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with feeders and branch circuits. Install for each branch circuit neutral originating from panelboards, including lighting circuits.

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

C. Size of equipment grounding conductors for branch circuits: As indicated in NEC-70, except minimum size shall be #12 AWG.

D. Size of branch panel feeder originating at switchboards/switchgear: As indicated in NEC-70, except in no instance smaller than #8 AWG.

E. Install equipment grounding conductor from secondary side of each transformer to grounding electrode system as required for separately derived system.

3.3 SEQUENCING, SCHEDULING

A. Permanently attach equipment grounds prior to energizing equipment.

3.4 INSTALLATION

A. Connections: Exposed and visible for inspection at all times. Do not install insulation over ground connections.

B. Identify all grounding conductors by system and room number of termination at building grounding electrode point.

C. 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.
D. Make grounding connections on surface that has been cleaned of paint, dirt, oil, etc., so that connections are bare metal to bare metal contact.

E. Make grounding connections tight with UL listed grounding devices, fittings, bushings, etc.

F. Equipment Grounding Conductor: Terminate in panelboard at green wire ground bus.

G. Multiple Conductors on Single Lug: Not permitted. Terminate each grounding conductor on its own terminal lug.

H. Flexible Metallic Conduit, Non-Metallic Rigid Conduit, or Liquid Tight Flexible Conduit: Install green wire grounding conductor with phase conductors in conduit.

END OF SECTION 26 0526
SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0533 – Raceway and Boxes for Electrical Systems

1.2 REFERENCE

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions and sections under Division 01 General Requirements.

1.3 DESCRIPTION

A. Section includes the following:
   1. Manufactured hangers and supports for individual raceways and cables, slotted channel and angle systems for multiple conduit runs, and most electrical equipment that is not floor mounted.
   2. Construction requirements for concrete housekeeping pads for floor-mounted electrical equipment.

1.4 REFERENCE STANDARDS

B. ASTM A 36/A 36M Carbon Structural Steel.
C. ASTM A 325 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
E. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.
F. MSS SP-69 Pipe Hangers and Supports - Selection and Application.
G. MFMA-4 Metal Framing Standards Publication.
I. NECA 101 Standard for Installing Steel Conduits (Rigid, IMC, EMT).
J. NFPA 70 National Electrical Code.
K. SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel.

1.5 QUALITY ASSURANCE

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. 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 5 times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Finishes
      a. Metallic Coatings:
         1) Factory standard primed, galvanized of electroplated finish and applied according to MFMA-4, for indoor applications.
         2) Hot-dip galvanized after fabrication and applied according to MFMA-4, for outdoor applications.
      b. Nonmetallic Coatings: Manufacturer’s standard PVC, polyurethane, or polyester coating applied according to MFMA-4, for corrosive environments.
      c. Painted Coatings: Manufacturer’s standard painted coating applied according to MFMA-4.
   2. Channel Dimensions: Selected for applicable load criteria.
   3. Manufacturers:
      a. Allied Support Systems; Power-Strut Unit.
      b. Cooper B-Line, Inc.; A division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corporation.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
      h. National Pipe Hanger Corporation.
      i. Michigan Hanger Co., Inc.; O-Strut Division.
      j. Approved equal.

C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16” diameter holes at a maximum of 8” o.c., in at least one surface.
   1. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
   2. Fitting and Accessory Materials: Same as channels and angles
   3. Rated Strength: Selected to suit applicable load criteria.
   4. Manufacturers:
      a. Allied Support Systems; Power-Strut Unit
      b. Cooper B-Line, Inc.; A division of Cooper Industries
      c. Fabco Plastics Wholesale Limited
      d. Seasafe, Inc.
      e. Approved equal

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

E. Raceway and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
F. Support for Conductors in Vertical Raceway: 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.

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

H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; A division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit
         5) 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. Manufacturers:
         1) Cooper B-Line, Inc.; A division of Cooper Industries
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; A division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
         6) 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:
      a. MSS SP-58; threaded steel, with adjusting and lock nuts; electroplated zinc finish.
      b. MSS SP-58; nonmetallic, with adjusting and lock nuts.

2.2 FABRICATED METAL FRAMING 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; not be lighter than 12ga.

C. Finish: Epoxy paint

D. Manufacturers: Same as in paragraph 2.1.B.3 above.
2.3 CONTINUOUS INSERT CHANNELS

A. Length and support capabilities to be suitable for application.

B. Brackets, inserts and accessories suitable for channel insert selected.

C. Manufacturers:
   1. Unistrut; Tyco International, Ltd.
   2. Cooper B-Line, Inc.; A division of Cooper Industries
   3. Michigan Hanger Co., O-Strut Division
   5. Approved equal

PART 3 - EXECUTION

3.1 APPLICATION

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

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70.
   1. Size steel hanger rods for individual hangers and trapeze supports as indicated in the following schedule. Total weight of equipment shall not exceed limits indicated.

<table>
<thead>
<tr>
<th>Maximum Loads (lbs)</th>
<th>Rod Diameter (&quot;)</th>
<th>Maximum Pipe Size With Single Rod</th>
</tr>
</thead>
<tbody>
<tr>
<td>730</td>
<td>3/8</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1130</td>
<td>1/2</td>
<td>3&quot;</td>
</tr>
<tr>
<td>1818</td>
<td>5/8</td>
<td>5&quot;</td>
</tr>
</tbody>
</table>

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25% in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with 2-bolt conduit clamps.

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

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements, except as specified in paragraphs below.

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

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4” thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4” thick.

6. To Light Steel: Sheet metal screws.

7. 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.

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

E. Do not support raceway by other raceway.

F. Do not support equipment or raceway from metal roof decking or floor decking.

G. Do not impose weight of electrical equipment, raceways, or lighting fixtures on support provided for other trades or systems.

H. Do not support loads from bottom chord member of trusses or open web chord.

I. Suspend hangers by means of hanger rods. Perforated band iron and flat wire (strap iron) are not allowed.

J. Use conduit-mounting pedestals for piping on roof. Install bottom of pedestal flat on roof deck and insulate exterior of pedestal, flush and counter flush.

K. Minimize use of concrete anchors and inserts after concrete pour.

L. Punching, drilling, welding of building structural steel or welding attachment to building structural steel is not allowed, unless approved by structural engineer.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

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

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

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

3.4 PAINTING

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

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

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

END OF SECTION 26 0529
SECTION 26 0533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables
   B. Section 26 0526 – Grounding and Bonding for Electrical Systems
   C. Section 26 0529 – Hangers and Supports for Electrical Systems

1.2 REFERENCE
   A. Work under this section is subject to requirements of Contract Documents including General
      Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION
   A. Section includes raceways, fittings, wireways, wall ducts, indoor service poles, outlet boxes, pull and
      junction boxes, floor boxes, tap boxes and raceway seals.

1.4 REFERENCE STANDARDS
   A. ANSI/NECA 1 Standard Practices for Good Workmanship in Electrical Contracting
   B. ANSI C80-1 Rigid Steel Conduit-Zinc Coated (GRS)
   C. ANSI C80-3 Electrical Metallic Tubing-Zinc Coated (EMT)
   D. ASTM A 53/A 53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded
      and Seamless
   F. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)
   G. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical
      Metallic Tubing and Cable
   H. NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
   I. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
   J. NEMA RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit
      and Intermediate Metal Conduit
   K. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Conduit
   L. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing
   M. NFPA 70 National Electrical Code
N. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces

O. UL 1 Flexible Metal Conduit

P. UL 6 Electrical Rigid Metallic Conduit-Steel

Q. UL 6A Electrical Rigid Metallic Conduit-Aluminum and Stainless Steel

R. UL 360 Liquid-Tight Flexible Steel Conduit

S. UL 514A Metallic Outlet Boxes

T. UL 514B Conduit, Tubing, and Cable Fittings

U. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

V. UL 651 Schedule 40 and 80 Rigid PVC Conduit and Fittings

W. UL 797 Electrical Metallic Tubing-Steel

X. UL 870 Wireways, Auxiliary Gutters, and Associated Fittings

Y. UL 1242 Electrical Intermediate Metal Conduit-Steel

Z. UL 1660 Liquid-Tight Flexible Nonmetallic Conduit

AA. UL 2024 Optical Fiber and Communication Cable Raceway

1.5 SUBMITTALS

A. Product Data:
   1. Raceways
   2. Fittings
   3. Wireways
   4. Pull and junction boxes

B. Manufacturer’s Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

C. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual routing of raceways larger than 2”.
      b. Record actual location and mounting heights of wireways, wall ducts, indoor service poles, floor boxes, tap boxes, outlet, pull and junction boxes.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include spare parts data listing, source, and current prices of replacement parts and supplies.
1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.

B. Protect PVC conduit from sunlight.

C. Comply with manufacturer’s written instructions.

1.8 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

A. Rigid Steel Conduit (RSC): ANSI C80.1, UL 6; heavy wall galvanized steel

B. Fittings (couplings, conduit bodies, connectors and bushings): NEMA FB 1, UL 514B; steel threaded; connectors with double locknuts and steel insulating bushings, thermoplastic insulating bushings for conduits 2” and smaller; conduit bodies cover: steel with stainless steel screws and neoprene gaskets; PVC coated to match conduit.

C. Fittings Manufacturers: Cooper Crouse-Hinds; Carlon Electric Products; O-Z/Gedney; Appleton; Hubbell

2.2 ELECTRICAL METALLIC TUBING (EMT)

A. ANSI C80.3, UL 797; galvanized steel tubing

B. Fittings (couplings, conduit bodies, and connectors): NEMA FB I, UL 514B; steel, watertight gland compression type connectors with double locknuts and insulated throat; conduit bodies cover: with stainless steel screws and neoprene gaskets. Indentor, drive-on, die-cast or pressure cast fittings not permitted.

C. Fittings Manufacturers: Same as manufacturers listed in 2.1.C.

2.3 PULL AND JUNCTION BOXES

A. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1; galvanized steel

B. Minimum size: 4” square by 2-1/8” deep for use with 1” conduit and smaller; 4-11/16” square by 2-1/8” deep for use with 1-1/4” conduit and larger
C. Sheet Metal Boxes Larger Than 12" in any direction: Hinged cover or a chain installed between box and cover

D. Field-fabricated boxes not allowed without prior approval of local authority having jurisdiction.

E. Manufacturers: O-Z/Gedney; Raco; Cooper Crouse-Hinds;

2.4 EXPANSION FITTINGS

A. Malleable iron, hot dip galvanized allowing 4" (±2") raceway movement.

B. Manufacturers: OZ/Gedney AX Series; or equivalent by manufacturer listed in 2.1.C.

2.5 RACEWAY PENETRATION SEALS

A. Thruwall and Floor Seals.

B. Manufacturers: New construction – OZ/Gedney FSK Series; existing construction – OZ/Gedney CSM Series; or equivalent by manufacturer listed in 2.1.C.

2.6 RACEWAY SEALING FITTINGS

A. For one through four conductors: Manufacturers: OZ/Gedney CSB Series For greater than four conductors: Manufacturers: OZ/Gedney EYA Series with sealing compound

B. Low-temperature or hazardous locations: Manufacturers: OZ/Gedney EYA Series with sealing compound;

2.7 SLEEVES FOR RACEWAYS

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

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052" or 0.138" thickness and of length to suit application.

C. Integral Water Stop: Manufacturer: Thunderline Corporation;
   1. High density polyethylene (HDPE). Type Century-Line engineered sleeve with end caps.
   2. Steel. Type WS engineered sleeve.

2.8 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
   1. Sealing Elements: interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   2. Pressure Plates: Plastic. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.
PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate with Architect/Engineer size and location of required built-in openings in building structure, including those sleeved, formed or core drilled.

B. Coordinate with Architect/Engineer cutting, removing, or piercing general or mechanical insulation, fire-rated walls, ceilings or steelwork.

C. Verify with Architect/Engineer all surface raceway installations except in mechanical, electrical, and communications rooms.

D. Coordinate routing of through-roof conduits.

E. Verify that exterior wall or wet location boxes are gasketed type cast boxes with matching cover.

F. Verify with manufacturer that “touch-up” paint kit and PVC-coating kit are available for use.

3.2 EXAMINATION

A. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of raceway’s installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Raceways:
   1. Comply with ANSI/NECA 1 and NFPA 70 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this Section are stricter.
   2. Arrange raceways to maintain headroom and present neat appearance.
   3. Raceway routing is shown in approximate locations, unless dimensioned. Route to complete raceway installation before starting conductor installation.
   4. Keep raceways at least 6" away from parallel runs of fuels, steam, hot-water pipes or ductwork. Install horizontal raceway runs above water and steam piping. Install raceways level and square and at proper elevations: 6'-6" minimum headroom, except in exit pathways 7'-0" minimum headroom. Do not block access to junction boxes, mechanical equipment or prevent removal of ceiling panels, etc.
   5. Run raceways concealed in construction to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid materials and equipment of other trades, except where noted otherwise.
   6. Avoid exposed raceway runs. Run raceways exposed where impractical or impossible to conceal or where specific approval is obtained. Run exposed raceways grouped and parallel or perpendicular to construction. Do not route exposed raceways over boilers or other high-temperature machinery or in contact with such equipment. Offset exposed raceways at boxes.
   7. Route raceways installed above accessible ceilings parallel or perpendicular to construction.
   8. Do not install raceways in structural or topping floor slabs, except where noted on the plans. Install raceway in structural or topping floor slabs, where noted on plans, as follows:
      a. Center raceways in structural slabs clear of reinforcing steel, except where crossing same, and spaced on centers equal or exceeding 3 times the raceway diameter. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in concrete.
      b. Outside diameter of raceway shall not exceed 1/3 the structural slab thickness.
      c. Obtain approval from Engineer for each run of raceway 1" or larger.
d. Do not install raceways in topping slabs of 2" or less.
e. Locate raceways to avoid conflict with equipment, door bucks, partitions and other equipment bolted to floor.

9. Cut raceways square using saw or pipe cutter.

10. Use hydraulic one-shot raceway bender or factory elbows for bends in raceway larger than 2", unless sweep elbows required. Bend raceways according to manufacturer’s recommendations. Do not use torches or open flame to aid in bend of PVC conduit.

11. Use raceway fittings compatible with raceways and suitable for use and environment.

12. Provide bushings on all raceways

13. Raceways minimum sizes:
   a. Minimum raceway size 3/4", except as noted on drawings.
   b. Minimum home run size: 3/4" except as noted on drawings.

14. Feed devices on same wall vertically from above or junction box in suspended ceiling.
   a. Do not install horizontal bends in conduit around corners.
   b. Feed devices in exterior or load-bearing walls by horizontal conduit runs.
   c. Where horizontal conduit runs are required or allowed, install conduits from device to device on same wall.

15. Raceways Supports:
   a. Independently support or attach raceway system to structural parts of construction. Suspended ceiling systems shall not be considered as structural parts of construction for raceway support. Do not attach raceways to piping system.
   b. Raceway supports for horizontal or vertical single runs:
      1) Hot dipped galvanized heavy-duty sheet steel straps, mineralac clamps or steel slotted support channel system with appropriate components.
      2) Spring steel type pressure clamps for raceways 3/4" and smaller.
   c. Raceway supports for horizontal and vertical multiple runs:
      1) Trapeze-type supports fabricated with steel slotted channel systems with appropriate components.
      2) Support horizontal runs with appropriately sized rods.
      3) Anchor vertical runs to structure.
      4) Spring-steel type pressure clamps for raceways 3/4" and smaller.
   d. Vertical raceway runs 1-1/4" and larger passing through floors: Support at each floor with pipe riser clamps.
   e. Do not support raceways with wire, perforated pipe straps or plastic tie-wrap. Remove wires used for temporary support.
   f. Secure raceways in metal stud walls to prevent rattling.
   g. Arrange raceway supports to prevent misalignment during wiring installation.
   h. Do not fasten raceways to corrugated metal roof deck.
   i. For fasteners and supports, including steel slotted support systems, support devices, support spacing, support of conductors in vertical raceways, and hanger rod size, refer to Section 26 0529 – Hangers and Supports for Electrical Systems and NFPA 70.

16. Ground raceways per requirements in Section 26 0526 – Grounding and Bonding for Electrical Systems.

17. Flexible Conduit Connections: Use maximum of 72" of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   a. Use LFMC in damp or wet locations subject to severe physical damage.
   b. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

18. Install PVC-coated raceways in areas with corrosive atmosphere as noted on plans.
19. Install stainless steel raceway clamps, mounting hardware, supports, hangers, etc., when located in “wet” or “wash-down” areas.

B. Raceway Penetration Seals:
   1. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   2. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section “Maintenance of Joint Protection” for materials and installation.
   3. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.
   4. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1” annual clear space between pipe and sleeve for installing mechanical sleeve seals.
   5. Sleeve-Seal Installation: Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
   6. Provide chrome- or nickel-plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitor’s closets, storage rooms, etc., unless suspended ceilings are specified.
   7. Remove temporary sleeves, if used for form wall openings, prior to installation of permanent materials.

C. Raceway Sealing Fittings:
   1. Install listed watertight seals to prevent the passage of moisture and water vapor through raceway, where raceway passes from interior to exterior of the building, where raceway passes between areas of different temperatures such as into or out of cold rooms or freezers, where raceway enters room which at any time is subject to low or high temperatures and where raceway enters a room which at any time is subject to internal air pressures above or below normal.
   2. Install watertight seals in interior of all raceways passing through building roof, ground floor slab (when the raceway does not extend beyond building footprint), or through outside walls of building above or below grade. Seal on the end inside building, using raceway sealing fittings manufactured for the purpose. Locate fittings at suitable accessible locations. For concealed raceways install each fitting in flush steel box with blank cover plate to match finish of adjacent plates or surfaces.
   3. Seal raceways entering or passing through “hazardous (classified) areas” as defined in NFPA 70.

D. Sleeve Installation for Electrical Penetrations:
   1. 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.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Rectangular Sleeve Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50” and no side greater than 16”, thickness shall be 0.052”.
      b. For sleeve cross-section rectangle perimeter equal to, or greater than, 50” and 1 or more sides equal to, or greater than, 16”, thickness shall be 0.138”.
   4. 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.
   5. Cut sleeves to length for mounting flush with both surfaces of walls.
6. Extend sleeves installed in floors 2" above finished floor level.

3.4 Size pipe sleeves to provide 1/4" annular clear space between sleeve and raceway, unless sleeve seal is to be installed APPLICATION

A. Raceway uses permitted and not permitted per NFPA 70 requirements and as described below.

B. Rigid Metal Conduit (RMC) permitted to be installed as follows:
   1. Installations below grade and in or under concrete slabs
   2. All locations except corrosive atmospheres
   3. Hazardous locations
   4. Locations requiring mechanical protection

C. Intermediate Metallic Conduit (IMC) permitted to be installed as follows:
   1. Installation below grade and in or under concrete slabs
   2. All locations, except corrosive atmospheres
   3. Hazardous locations
   4. Locations requiring mechanical protection

D. Electrical Metallic Tubing (EMT) permitted to be installed as follows:
   1. Interior partitions
   2. Above suspended ceilings
   3. In concrete slabs
   4. 6 ft AFF in exposed areas of mechanical equipment rooms
   5. Sizes 2" and smaller except as approved

3.5 RACEWAY WIRING METHODS

A. Concealed Dry Locations: Install electrical metallic tubing install sheet metal boxes; install flush mounting outlet boxes in finished areas; install hinged enclosure for large pull boxes.

B. Exposed Dry Locations: Install rigid steel conduit; install sheet metal boxes; install flush mounting outlet boxes in finished areas; install hinged enclosure for large pull boxes.

3.6 FIELD QUALITY CONTROL

A. Inspect raceway, boxes, indoor service poles, and wireways for physical damage, proper alignment, supports and seismic restraints, where applicable.

B. Replace any damaged component of the raceway system, or install new raceway system.

C. Inspect components, wiring, connections and grounding.

3.7 REPAINTING

A. Repair damage to galvanized finishes with manufacturer-supplied zinc-rich paint kit. Leave remaining paint with Owner.

B. Repair damage to PVC or paint finishes with manufacturer-supplied touch-up coating. Leave remaining coating with Owner.

C. Wireways, indoor service poles: Remove paint splatters and other marks from surface; touch-up chips, scratches, or marred finished to match original finish using manufacturer-supplied paint kit. Leave remaining paint with Owner.
3.8 ADJUSTING

A. Adjust flush-mounted boxes pre-pour and after-pour to be flush with finished materials.

B. Install knockout closures in unused openings in boxes.

C. Align adjacent wall-mounted outlet boxes for switches and similar devices.

D. Adjust outlet boxes to allow luminaires to be positioned as indicated on drawings.

3.9 CLEANING

A. Clean interior and exterior of boxes, wireways, and indoor poles to remove dust, debris and other material.

END OF SECTION 26 0533
PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0000 - General Electrical Requirements

B. Section 26 5000 - Lighting

1.2 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION OF SYSTEM

A. Section includes automatically operated, PC-based, wireless lighting controls with external signal source and control modules.

B. Provide devices such as wall and ceiling mounted occupancy sensors, ambient light sensors, gateways, front end servers etc., as shown on drawings.

C. Devices of same type shall be from same manufacturer.

D. The lighting control system shall be non-proprietary to a single lighting manufacturer. The lighting control system shall have the flexibility to fully operate under multiple lighting fixture types or manufacturers.

1.4 REFERENCE STANDARDS

A. UL773A Non-Industrial Photoelectric Switches for Lighting Control.

B. UL924 Emergency Lighting and Power Equipment

C. NEMA WD 7 Occupancy Motion Sensors.

1.5 SUBMITTALS

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

B. Shop Drawings shall include:
   1. Bill of material
   2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
   4. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
   5. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
   1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
   2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

D. Samples: One for each type of device specified, in each color specified upon request.

E. Manufacturer’s Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

G. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations and type of devices.
   2. Operation and Maintenance Data:
      a. Include in manufacturers’ packing label warnings and instruction manuals with labeling conditions.
      b. Include source and current prices of replacement parts and supplies.

H. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Obtain devices from one source and by single manufacturer.

B. Factory Assembly:
   1. All devices shall be factory assembled and tested. All system components shall arrive at the job site complete and ready for installation, requiring only the connection of lighting circuits and network terminations.

C. Component Testing:
   1. All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.

D. NEMA Compliance:
   1. All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

E. Manufacturer must have a minimum of 10 years of experience manufacturing lighting controls.

F. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.
2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

G. Coordinate lighting control components to form an integrated interconnection of compatible components.
   1. Match components and interconnections for optimum performance of lighting control functions.
   2. Design display graphics showing building areas controlled; include the status of lighting controls in each area.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory unopened packaging until ready for installation.

1.8 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

C. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of software input/output to execute switching or dimming commands.
      b. Failure of modular relays to operate under manual or software commands.
      c. Damage of electronic components due to transient voltage surges.
   2. Warranty Period: Ten years from date of Substantial Completion.
   3. Extended Warranty Period Failure Due to Transient Voltage Surges: Ten years.

1.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of the software

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Exterior Occupancy Sensors: Hubbell
      a. Or Owner approved equal
   2. Exterior Photocells: Hubbell
      a. Or Owner approved equal
3. Timeclocks: Hubbell  
   a. Or Owner approved equal  
4. Gateways: Hubbell  
   a. Or Owner approved equal  
5. Lighting Control Server: Hubbell  
   a. Or Owner approved equal

B. It is the responsibility of Electrical Contractor to ensure devices submitted meet functional intent and design quality standards.

2.2 FABRICATION AND MANUFACTURE

A. Devices shall be UL listed for loads and voltages as indicated in contract drawings and specifications.

2.3 SYSTEM/NETWORK REQUIREMENTS

A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity.

B. Performance Requirements: Internal control unit, external sensors, or other control signal sources send a signal to a PC-based network-system control module that processes the signal according to its programming and routes an open or close command to one or more luminaires.

C. System shall consist of wireless, distributed and intelligent lighting control devices consisting of but not limited to control modules with ON/OFF and 0-10VDC full range dimming capabilities, and system input devices including but not limited to motion sensors, daylight sensors and manual switch stations.

D. Control modules shall be capable of measuring and monitoring the loads they control and report alarms for out of range values.

E. System shall have an architecture that creates a self organizing and self healing mesh network infrastructure.

F. System shall use a gateway controller for proper system operation. Each gateway shall support up to 1000 nodes.

G. System shall be self organizing. The mesh network of devices shall build automatically without the need to manually set device addresses via dials, DIP switches or other means.

H. System shall be self healing. System shall be capable to accept a failed node without compromising message delivery.

I. System nodes shall comprise user configurable fail safe and fault recovery mechanisms that will execute commands in case of lost communication such as default to photocell on/off control in case of failure or to the execution of internal schedules.

J. System nodes shall be able to maintain accurate date time while powered.

K. System shall be capable of storing diagnostic logs for troubleshooting purposes.

L. System architecture shall facilitate data transmission between each wireless device over the 2.4GHz or 900MHz ISM radio frequency (RF) bands with a supported and outdoor unobstructed RF range of 1000ft between each radio module.
M. System architecture shall allow for up to 32 hops (levels) of propagation in any direction and from any transmitter.

N. System shall secure all messages. When transmitting over the air, each wireless device shall use the strong and secure AES-128 (Advanced Encryption Standard) security cipher to encrypt and decrypt messages. System input devices shall be to monitor and broadcast changes such as Motion, daylight levels and manual switch input.

O. System shall have an intuitive and easy to use Graphical User Interface (GUI) to configure, control, monitor and schedule individual devices or groups of devices.

P. System shall remain fully functional during the programming process. Lighting control systems that must be taken "OFF LINE" for programming are not acceptable. All programming changes shall take effect immediately as they are programmed.

Q. Available reports shall include, but are not limited to:
   1. List of devices for a given site
   2. List of scenarios for a given group
   3. List of current alarms in the last X hours (the number of hours shall be selectable).
   4. List of alarms history in the last X period (the period shall be selectable with calendar fields).
   5. Energy Log in Report Form
   6. Energy Log in Chart Form
   7. Energy log detailed in report form. This report shall produce a list of each device for a given site with their KWH, KVAH, BURN TIME. The period covered shall be selectable with calendar fields
   8. All reports shall be generated in PDF, XLS or XLSX file formats.

R. System shall provide client-based or web-based applications for accessing the lighting controls network.

S. System shall offer installation tools allowing for automatic GPS location positioning (when outdoor) as well as installation validation while on site.

T. System shall allow both map and architectural (images) views alternative with devices overlaid on either type of views. Maps shall be sourced from multiple free providers.

2.4 WIRELESS RELAY FIXTURE MODULES

A. Internal and External Wireless Relay Modules shall provide universal voltage support from 110V to 480V.

B. External Relay Modules shall utilize the standardized ANSI C136.41-2013 (7 & 5 pin) receptacles.

C. Relay Modules shall be fully programmable and capable of storing and autonomously execute commands and scenarios with the following minimum functionalities. The operating scenarios described below shall reside within each addressable intelligent relays even in case of power outage. Systems which rely on the operator to develop these scenarios using a programming language will not be allowed.

D. Standard on all relay modules:
   1. Each node status after returning from Black Out shall be user programmable: with the following options: On – Off – Last Level – user defined including a random delay to execute.
   2. Variable Power Up delay, to smooth peak startup demand.
   3. Phase-angle and Analog 0-10V dimming relays
4. Ramping parameters (Brighten-Dim-Ramp up-Ramp Down-Night Mode – Ramp to Levels)
5. Definition of preset levels (min.: 10) with user configurable transition speed
6. Minimum dimming level, in order to adapt to various brands of dimming drivers (with the option to Stay On or turn off, below a set minimum level)
7. Monitoring, metering and reporting
8. Shall measure the following parameters:
   a. Power monitoring
      Voltage
      1) Amperage
      2) Power
      3) Power factor
   b. Cumulative Energy with a 2% accuracy
   c. Cumulative Lamp burn time
   d. Cumulative Ballast/Driver burn time
   e. Number of ON/OFF cycles
9. Alarms (ex: overvoltage, under voltage, over current, under current, low power factor, etc.) Alarms logs shall be stored in nonvolatile memory to allow for on demand subsequent retrievals
10. Time delay functions:
    a. (10) Generic timers with the ability to cascade up to (10) timers
    b. Selectable individually in each module covering 0-65534 seconds (18h).

E. System shall provide repeat capabilities to extend the range beyond normal radio range

2.5 WIRELESS GATEWAY

A. The Wireless Gateway specific capabilities shall meet or exceed the following:
1. Power loss memory and clock holdup time: minimum of 6 months
   a. Clock: Digital with time, day of week, and date
   b. Automatic leap year compensation.
2. Remote Communications
   a. Each Gateway shall support a minimum of two communications ports: a USB port for PLC and/or RF (802.15.4) and an Ethernet port. Either or both may be used for programming, monitoring, and control. The Ethernet port shall allow simultaneous operation of multiple communications access points (Client sessions, Remote Ethernet-PLC modems) to support multiple operator terminals and communications with other building automation systems
   b. All relay changes of state and programmable switch actions shall be communicated over both the local USB/XB network and the Ethernet to support interactive graphics and online status monitoring
3. Gateway must be fanless, 1GHz or faster processor, WIFI and Ethernet connectors, autoboott on power up, 1 GB RAM, 500M storage.
4. Gateway shall provide automatic recovery in case of power failure
5. Gateway shall support BACnet IP.

2.6 OPERATORS SOFTWARE

A. Graphical User Interface (GUI)
1. Data shall be entered through a simple Graphical User Interface and Multi-lingual software package, independently of the language of the operating system. The operating system shall be Windows 7 or more recent.

B. Activity Logs
1. Store the last 2 years events including the time and scenarios, commands or values, indicating which user executed the event or modification

C. Schedules
1. An unlimited number of schedules may be assigned to individual relays or groups of relays.
2. Each schedule shall allow an unlimited number of events per day, cloning of schedules shall be possible
3. Applicable period for individual schedules shall be user-defined, and include concepts of holidays, and special exclusion/inclusion periods
4. Schedules shall individually be specified to supersede or not Holidays and Special periods

D. Conditional Scheduling & Execution Engine
1. System shall be capable of building Conditional Scheduling & Execution rules, based on time of day, occupancy statuses, override keypads triggering Scenarios, etc.
2. Such Conditional Scheduling & Execution Engine enables the user-definition of flexible rules such as:
   a. Blink Warning
   b. Time Delay Overrides
   c. Preemptive Override
   d. Master Control
   e. Cleaning Scenarios
   f. Automatic Daylight with Occupant Override
3. System Parameters
4. Multiple sites may be programmed from a single software interface.
5. Allow an unlimited number of different user/passwords per site or per system
6. User defines functions accessible for each password (Add-Edit-Remove – Control – Access rights – Guest/Administrator)

2.7 EXTERIOR OCCUPANCY SENSORS
A. Exterior occupancy sensors shall:
1. Be a completely self-contained device capable of detecting presence in the controlled range by detecting changes between infrared energy in motion and the background space.
2. Utilize passive infrared detection technology and a three level Fresnel lens to increase detection density and accuracy of motion detection.
3. Be capable of mounting vertically or horizontally onto a standard outdoor junction box or integral to exterior luminaires.
4. Cover up to 35 ft with a field of view of 180 degrees or 52.5 ft with a field of view of 270 degrees.
5. Have an operating temperature range of -40°F to 130°F.
7. Include a built-in light level sensor, adjustable by the user that will keep lights from turning on during daylight hours.
8. Have user-adjustable time delay settings, including an override ON option that enables controlled lights to be turned on remotely for the length of the time delay.
9. Be compatible with all electronic ballasts and LED drivers with no minimum load requirements.
10. Provide continuous dimming control to reduce electric light levels from a minimum of 40% to a maximum of 80% based on area occupancy.

2.8 UL 924 EMERGENCY BYPASS/CONTROL DEVICES

A. UL 924 listed bypass relays shall:
   1. Be UL924 listed and labeled for connection to both normal and emergency lighting power sources.
   2. Have universal rated voltage inputs 120-277 VAC, 60 Hz.
   3. Have normally closed dry contacts rated for switching 120-277 volts, 60 Hz. 20 amp loads.
   5. Have auxiliary isolated normally closed contact for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure.
   6. Have status indication for presence of normal and emergency power sources and current operational mode (normal or emergency).
   7. Utilize zero crossing circuitry to protect relay contacts from the damaging effects of inrush current generated by switching electronic ballast loads.
   8. Be forced into the emergency mode upon loss of normal power sense and turn ON the emergency lighting.
   9. Automatically switch emergency lighting ON/OFF as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting ON regardless of the state of any external control device until normal power is restored.

B. Operational temperature range shall be -40°F to 140°F.

C. Device shall have universal mounting; surface, above suspended ceiling or recessed.

2.9 EXTERIOR PHOTOCELLS

A. Photocells shall:
   1. Have universal rated voltage inputs 120-277 VAC, 60 Hz.
   2. Be rated for up to 2,000 watts.
   3. Have cadmium sulfide, 1" diameter cell.
   4. Have SPST normally closed contacts.
   5. Have a minimum delay of 3 minutes to prevent false switching.

B. ON/OFF adjustment shall be done by moving light selector with range from 2 to 50 footcandles.

C. Operational temperature range shall be -40°F to 140°F.

D. Enclosure shall be die cast zinc, gasketed for maximum weatherproofing.

E. Enclosure shall include positioning lug on top.

F. Mounting shall be for 1/2" conduit nipple.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices at heights scheduled, and as indicated on drawings.

B. Install ceiling devices as shown on drawings and as recommended by device manufacturer.

C. Install devices plumb, level with finished surfaces and free from blemishes.

D. Verify device locations prior to rough in.

E. Electrical Contractor shall be responsible for final adjustment and testing of all devices.

3.2 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Provide current licenses for software.

3.3 DEMONSTRATION

A. Engage a factory -authorized service representative to train owner’s maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems.

3.4 TESTING

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Verify proper location and operation of all devices.

C. Adjust occupancy sensors for a 30 minute time delay or as specified in the construction documents.

D. Adjust occupancy sensor sensitivity such that movement outside range of coverage shall not trigger sensor.

E. Adjust ambient light sensor to maintain illuminance level equal to light level from controlled lighting in the space when no daylight is present or as indicated per drawings. Demonstrate ambient light sensor(s) control lighting as specified.

F. Tests and Inspections:
   1. Verify that the control module features are operational.
   2. Check operation of local override controls.
   3. Test system diagnostics by simulating improper operation of several components.

G. Lighting controls will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 0923
PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0000 - General Electrical Requirements
B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables
C. Section 26 0526 - Grounding and Bonding for Electrical Systems
D. Section 26 0533 - Raceway and Boxes for Electrical Systems

1.2 DESCRIPTION OF WORK

A. Provide complete and fully operational lighting system per Contract Drawings and Specifications.
B. Luminaires shall be provided complete with necessary accessories for proper installation.
C. Catalog numbers shown in luminaire schedule are basic luminaire types. Additional features, accessories and options specified, scheduled or necessary for proper installation shall be included.
D. Provide lamps for luminaires as recommended by luminaire manufacturer, unless noted otherwise.
E. Specifications and drawings convey the features and functions of luminaires only and do not show every item or detail necessary for the work.
F. Work includes final aiming and focusing of luminaires under direction of the Engineer.

1.3 REFERENCE STANDARDS

A. NECA/IESNA 501 Standard for Installing Exterior Lighting Systems (ANSI)
B. UL 773 Plug-in Photo Controls for use with area lighting
C. UL 924 Emergency Lighting and Power Equipment
D. UL 1598 Luminaires
E. UL 2108 Low Voltage Lighting Systems
F. UL 2388 Flexible Lighting Products
G. UL 2562 Pendant Cable
H. UL 8750 LED Light Sources for use in Lighting Products
I. ANSI C78.377 Chromaticity
J. IESNA LM-79 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
K. IESNA LM-80  
Approved Method: Testing Lumen Maintenance of LED Light Sources

L. IESNA TM21-11  
Projecting Long Term Lumen Maintenance of LED Light Sources including Addendum A

1.4 QUALITY ASSURANCE

A. Luminaire and accessory components shall be constructed of materials appropriate for their use.

B. Luminaire, ballasts, drivers, lamps and other components shall meet the requirements of all applicable State and Municipal codes and energy codes.

C. Provide luminaire listed and labeled by UL or other testing lab acceptable to local jurisdiction for their indicated use and installation conditions.

D. Contractor shall coordinate installation of lighting systems with all trades.

Manufacturer listed in the luminaire schedule shall be assumed capable of supplying listed luminaires. Any such exceptions shall immediately be brought to the attention of the Engineer. All substitutions shall be equal to or exceed the specified performance data. All substitution requests are subject to Owner approval.

1. Single Name Specification:

a. When only one product is suitable for the application and/or no other known acceptable products exist, only one manufacturer/product is listed in the Luminaire Schedule. For such instances, Electrical Contractor shall provide the listed product. All substitutions shall be equal to or exceed the specified performance data. All substitution requests are subject to Owner approval.

b. Specifier has secured accurate pricing for all single name products prior to bidding and has shared this information with Owner's Representative. Contractor shall supply equipment only and not include installation or miscellaneous electrical costs.

2. Contractor shall coordinate and verify compatibility of luminaires with lighting control system

a. Control protocol indicated for luminaires matches protocol of lighting control system specified. Contractor shall coordinate and verify compatibility of all dimming luminaires with control system to ensure that dimming is flicker free, continuous dimming through the dimming range noted on the luminaire schedule.

1.5 WARRANTY

A. LED Luminaires: Provide Manufacturer's warranty for a period of not less than ten years from the date of substantial completion or the specified warranty period greater than ten years for repair or replacement of defective electrical parts, including light source and driver.

1.6 SUBMITTALS

A. After award of Contract, submit complete list of lighting products to be furnished, with manufacturer and catalog designations, including currently quoted lead times for product delivery. Should Electrical Contractor anticipate delivery schedule of any specified product may adversely impact construction schedule, they shall bring it to the attention of the Owner/Engineer at this time.

B. In addition to complying with requirements of Section 26 0000 - General Electrical Requirements, submittals shall include the following:

1. Manufacturer’s product data
2. Installation instructions
3. Maintenance data
4. Parts list for each luminaire accessory
5. Photometric Data: photometric data for luminaire, including optical performance as follows:
   a. Coefficients of utilization
   b. Luminance table
   c. Candela distribution data
   d. Zonal lumens
   e. Area and roadway luminaires shall include Isocandela Charts, IES Roadway Distribution Classification and IES BUG (Backlight – Uplight – Glare) ratings.
6. Ballast and Driver schedule indicating manufacturer, type, and catalog number for each luminaire.
7. Driver cut sheet for each driver used, referencing luminaire type(s)
8. Lamp schedule indicating manufacturer, type, and catalog number for each luminaire
9. Lamp cut sheet for each lamp used, referencing luminaire type(s)
10. Documentation of lamp and ballast or LED and driver compatibility
11. Product color/finish
   a. Where specific finish or color is not specified and options exist, submit color or finish samples to Engineer for selection.

C. Shop Drawings for equipment provided under this Section shall include the following:
1. Overall submittal drawings indicating luminaire size, mounting (including ceiling type), light source, shielding, and voltage attributes, as well as manufacturer’s product data, installation instructions, maintenance data, and parts list for each luminaire.
2. Catalog cutsheets lacking sufficient detail will not be accepted.
3. Detailed drawings of linear pendant mounted and suspended luminaires including dimensions, support spacing, suspension type, power feed type and locations, lamp combinations, ballast/driver locations, wiring and controls configuration, luminaire joint locations and end plates. Provide canopy details that indicate coordination with the ceiling system provided.
4. Detailed drawings for LED systems including LED color, color consistency, rated life, warranty, and scale plans with luminaire layout, number, type and location for drivers, and a complete bill of materials.
5. For LED luminaires, submit documentation that indicates specified products have been tested, or will be tested, for compatibility with the lighting controls being procured and will perform as specified. Control devices or system shall be able to control luminaires with flicker free, continuous dimming, in range specified. The Electrical Contractor, luminaire manufacturer and lighting control manufacturer shall be financially responsible for any incompatibilities.
6. Detailed drawings for nonstandard/custom luminaires indicating dimensions, weights, method of field assembly, components, features, and accessories. Details shall be scaled to a legible size.
7. Photometric Data: Where indicated on luminaire schedule and Contract Drawings, supply complete photometric data for luminaire, including optical performance rendered by independent testing laboratory developed according to methods of the Illuminating Engineering Society of North America as follows:
   a. Coefficients of utilization
   b. Luminance table with data presented numerically, showing maximum luminaire luminance at shielding angles. Readings should be taken both crosswise and lengthwise in case of fluorescent luminaire or luminaire with an asymmetric distribution.
   c. Candela distribution data, presented graphically and numerically, in 5° increments (5°, 10°, 15°, etc.) Data developed for up and down quadrants normal, parallel, and at 11-1/2°, 45°, 67-1/2° to lamps if light output is asymmetric.
d. Zonal lumens stated numerically in 10° increments (5°, 15°, etc.) as above.

8. No variation from the general arrangement and details indicated on drawings shall be made on shop drawings unless required by actual conditions. All variations shall be marked on drawings submitted for approval.

D. Provide luminaires with factory or field finish as directed by Engineer. Verify final finish requirements before releasing luminaires for fabrication.

E. Where specific finish or color is not specified and options exist, submit color or finish samples to Engineer for selection. Luminaires not having color or finish acceptable to Engineer shall be replaced at no additional cost.

1.7 SAMPLES

A. Upon return of submittals, and prior to release for manufacturing, Contractor shall furnish one working sample of each luminaire for which sample requirement is noted in the Luminaire Schedule.
   1. All requested samples shall be furnished as specified on luminaire schedule including but not limited to: light output, correlated color temperature, distribution, lens type and finish.

B. Shipping: Samples shall be complete with specified lamp(s) or LED module(s), cord and plug, ready for hanging, energizing, and examining, and shall be shipped, prepaid by Contractor, to Engineer or as otherwise advised.

C. Samples will not be returned, nor included in quantities listed for project.

D. Sample must be actual working unit.

E. All custom luminaires require a submission of material finish samples, component approval and a complete operating prototype luminaire. Prototype to be submitted prior to commencement of final luminaire fabrication and shall include specified lamps. Modifications may be required as a result of the prototype review. These modifications and others that do not materially affect the cost of the luminaire shall be incorporated at no additional cost to the owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Luminaires:
   1. As shown on Luminaire Schedule
      a. Or Owner approved equal.

B. LED Drivers
   1. Shall be manufacturer recommended compatible driver.
   2. All LED drivers shall be dimming type standard unless otherwise noted. Refer to construction documents for control per application.
   3. Manufacturers must be compatible with lighting control system(s) provided and control luminaires from 100% to 1% light output or 100% to 10% light output per Luminaire Schedule and controls intent documents.

C. LED Modules
   1. As shown on Luminaire Schedule
      a. Or Owner approved equal.
2.2 FABRICATION AND MANUFACTURER

A. Luminaires:
   1. Construction
      a. Luminaires shall bear label indicating circuit voltage. Labels shall not be visible from normal viewing angles.
      b. Luminaires shall be constructed with joints made by means of welded, brazed, screwed, or bolted construction methods.
      c. Housings shall be so constructed that all electrical components are accessible and replaceable without removing luminaires from their mountings.
      d. Surface temperatures of luminaires with ballasts or integral drivers shall not exceed 90°C in 30°C ambient.
      e. Luminaires recessed in ceilings utilized as air handling plenums shall be certified as suitable for the purpose and conform with NEC Article 300.
      f. Miter cuts shall be accurate, joints shall be flush and without burrs.
      g. Luminaires shall be free of light leaks and designed to provide sufficient ventilation of lamps to provide the photometric performance documented. Ballasts, low voltage transformers and drivers shall be vented per manufacturer’s specifications.
      h. Provide inscription for exit and stairway signs to conform to applicable codes.
      i. Verify types of ceiling construction with General Contractor prior to releasing luminaires for fabrication and delivery and provide luminaires adapted to ceiling construction used.
      j. Coordinate recessed luminaire mounting appurtenances, flanges and trims with construction of ceiling in which luminaire is to be recessed. Provide correct luminaire mounting assembly.
      k. Luminaire frames shall be manufactured of non-ferrous metal or be suitably rust proofed after fabrication.
      l. Recessed high intensity discharge luminaires with integral ballasts, installed indoors, shall have UL listed thermal protection integral with ballast. Exceptions are luminaires installed in suspended lay-in, grid type ceilings and which comply with UL suspended ceiling luminaire listing.

   2. LED Luminaires are considered a lighting system with dependent components that must be evaluated as a complete system. Each LED luminaire includes a light emitting source, provisions for heat transfer, electrical control, optical control, mechanical support and protection, as well as aesthetic design elements. All LED luminaires shall:
      a. Be UL listed or equivalent. Where remote drivers are specified, all drivers shall also have UL listing or equivalent and comply with code requirements.
      b. Be tested to IESNA LM-79-08 testing using absolute photometry criteria.
      c. Be rated at > or = to 70% lumen maintenance at 100,000 hours of operation.
      d. Be rapid cycle stress tested.
      e. Have integral lamp modules with a minimum operating temperature of -20°C.
      f. Have lamp modules that are capable of being easily replaced upon failure with a manufacturer provided replacement module without voiding the UL listing of the luminaire.
      g. Have driver housings easily accessible for ease of maintenance.
      h. Have a maximum operating temperature at LED junction to not exceed 90°C over the expected operating range of the luminaire.
      i. Be RoHS compliant, lead and mercury free.
      j. Have an LED operating frequency of + or – 120 Hz.
      k. Must meet the appropriate Federal Communications Commission (FCC) requirements for FCC 47 CFR 15 (consumer use) and/or FCC 47 CFR Part 18 (industrial use)
      l. Be Class A Sound rated.
m. Be supplied with power supply that complies with IEEE C. 62.41-1991.

n. Operate at 120 or 277 volts, +/- 10%.

o. Have reverse polarity protected at all hardwired connections and have high voltage protection in the event connections are reversed or shorted during the installation process.

3. Lenses, Reflectors and Diffusers
   a. All lenses or louvers shall be removable, but held so that normal motion will not cause them to drop out.
   b. All glass used in LED luminaires shall be made from thermal shock resistant borosilicate glass.
   c. Optical lenses shall be free from spherical and chromatic aberrations.
   d. Acrylic lenses shall be 100% virgin acrylic material.
   e. Diffuser materials shall be UV stabilized in applications exposed to sunlight.
   f. LED troffer lenses shall be 0.125” thick, unless otherwise noted.
   g. Alzak reflectors and louvers shall be low iridescent equivalent to Coil Anodizers. All Alzak parabolic cones shall be guaranteed against discoloration for a minimum of ten years.
   h. Reflector cones shall not have visible lamp flashing in the cone.

4. Optics and Adjustments
   a. Lamp holders shall be suitable for the indicated lamps and shall be set such that lamps are positioned in optically correct relation to all luminaire components.

5. Finishes
   a. Provide luminaires with finish as shown in the luminaire schedule. Verify final finish requirements before releasing luminaires for fabrication.
   b. Painted luminaires shall be painted after fabrication or "post painted”.
   c. Ferrous parts and supports shall be rust proofed after fabrication.
   d. For weatherproof or vaportight installations, painted finishes of luminaires and accessories shall be weather resistant using proper primers or galvanized and bonderized epoxy, so that the entire assembly is completely corrosion resistant for the service intended and rated for an outdoor life expectancy of not less than 20 years.

6. Wiring
   a. Luminaires shall be completely wired at the factory and as required by code.
   b. Internal wiring shall contain no splices.
   c. Connections shall be made with insulated "wire nut" type mechanical connectors except that ballast and driver connections shall comply with NEC Article 410.
   d. Wire for connections to lamp sockets and lamp auxiliaries shall be minimum #16 AWG luminaire wire.
   e. Luminaires shall be provided with flexible conduit, pigtails, and equipment for external connections.
   f. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.
   g. Provide lamps for all luminaires.

7. Ceiling Coordination
   a. Verify type of ceiling construction prior to releasing luminaires for fabrication and delivery.
   b. Provide mounting appurtenance, flanges, sloped ceiling adaptors where required.
   c. Provide mounting assembly, clips or other mechanical mounting lugs as required for support of luminaires.
8. Outdoor Lighting Systems:
   a. Provide luminaires, mounting arms, brackets, poles, hand-hole covers, base components, and all other accessories for a complete assembly. Manufacturers shall be responsible for proper fitting of all elements and the structural integrity of the unit.
   b. Exterior Luminaires:
      1) Shall operate at a minimum ambient temperature of 0°F.
      2) Shall be fully gasketed, with UL wet location label.
      3) Shall have approved wire mesh screens for ventilation openings.
      4) Anodized aluminum reflectors shall have minimum of 0.00079" anodizing thickness.
   c. Pole/Luminaire combination shall have EPA rating that will withstand site wind conditions.
   d. All castings and extrusions shall be given minimum one coat of baked-on clear lacquer, unless painted finish is specified.
   e. Aluminum surfaces shall receive a duronodic or polyester powder paint finish.
   f. Cast-in Luminaire housings installed directly in concrete shall be fabricated of hot dip galvanized steel or cast aluminum or composite.
   g. Where cast aluminum housings are used, give two coats of asphaltum paint prior to installation.
   h. Provide 1/8" thick x 2" diameter solid neoprene grommets at each point light luminaire surfaces are mounted to concrete structure.
   i. Provide with bird deterrent.

2.3 DRIVERS

A. LED Drivers and Power Supplies shall:
   1. Operate system LEDs within the current limit specification of the LED manufacturer.
   2. Be supplied with over-temperature protection circuitry.
   3. Be programmable to allow for LED replacement modules to be “tuned” to match the output of remaining adjacent modules in the event that some time has passed and there has been lumen depreciation.
   4. Be within a NEMA enclosure.
   5. Be equipped with knockouts to accommodate standard conduit sizes
   6. Have a Power Factor to be = or > than 0.9
   7. Have a Lamp Current Crest Factor < 1.5
   8. Dimmable LED drivers must be compatible with dimming system(s) provided and control luminaires per luminaire schedule and controls documentation.
   9. ETL certified, CBM and UL Listed, high power factor, and meet or exceed NEMA and ANSI Standards.
   10. Class A sound rated
   11. Equipped with resetting thermal sensitive device.
   12. For operation at 60 Hz and voltage as scheduled.
   13. Meet or exceed all ANSI or NEMA standards
   14. Capable of operating LEDs with less than 5% flicker

B. LED Data Enablers shall be:
   1. NEMA enclosure.
   2. Equipped with knockouts to accommodate standard conduit sizes.
   3. Convection cooled.
   4. RoHS compliant.
2.4 LAMPS

A. Provide lamps as noted on Luminaire Schedule.

B. Provide lamps of same type from same manufacturer.

C. Where a specific lamp manufacturer has been indicated in the Luminaire Schedule, lamps shall be supplied from named manufacturer only.

D. White LED sources shall be:
   1. Minimum CRI of 70 or greater unless noted otherwise on Luminaire Schedule
   2. Less than 5% flicker
   3. Within 0.004 on the CIE 1976 diagram for color spatial uniformity
   4. Within 0.007 on the CIE 1976 diagram for color maintenance over the rated lifetime of the source
   5. Binned within a 3-step MacAdam ellipse minimum, or as indicated in the Luminaire Schedule
   6. Color temperature as noted on Luminaire Schedule
   7. Have a published life rating based on the point at which LED sources reach L70 lumen maintenance and tested in accordance with the IES LM80-08 Approved Method: Testing Lumen Maintenance of LED light sources and IES TM-21-11: Projecting Long Term Lumen Maintenance of LED Light Sources
   8. L70 rated life shall be a minimum of 100,000 hours.
   9. All LED modules, unless noted otherwise, shall be provided by the light fixtures manufacturer and integral to the luminaire.
   10. IP rating of IP65 or better
   11. Efficiency of luminaire must be 85 lumens per watt or greater.

E. Provide all other lamp types and special purpose lamps as noted on Luminaire Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Marking:
   1. Voltage identification: Luminaires designed for voltages other than 110-125 volt circuits shall be clearly marked with rated voltage.
   2. Markings must be clear and shall be located to be readily visible to service personnel but invisible from normal viewing angles when lamps are in place.

B. Installation of Luminaires:
   1. Lamps, glassware, reflectors and refractors shall be clean and free of chips, cracks and scratches.
   2. Install decorative luminaires, reflector cones, baffles, aperture plates, lenses, trims, and decorative elements of recessed luminaires after completion of ceiling tile, plastering, painting, and general cleanup is completed. Where luminaire location or construction does not permit sequential installation, all reflectors, lenses, flanges and other visible surfaces shall be carefully protected.
   3. Light leaks between ceiling trim of recessed luminaires and ceiling are not allowed.
   4. Locations
      a. Install luminaires at locations and heights as indicated.
      b. Do not scale electrical drawings for locations of luminaires.
c. Where noted on the drawings, the exact location of luminaires shall be confirmed (in the field) with the Engineer prior to installation.

d. Where luminaires are to be concealed, or surface mounted in highly visible public spaces, a small sampling of luminaires shall be installed, adjusted and aimed for Engineer's review approval, prior to installing remaining luminaire of same type.

e. Mount all luminaires so as to maintain full range of motion.

f. Install luminaires plumb, square, and level with ceilings and walls.

g. Coordinate stem, rod, chain, or aircraft cable hanger lengths with job conditions.

h. Industrial type luminaires in unfinished areas, which are near obstructions such as ducts and pipes, shall be:
   1) Suspended so that bottom of luminaire is no higher than bottom of obstruction
   2) Located at height of lowest luminaire
   3) Minimum height: 8'-0"
   4) Shall not be located until locations of obstructions are determined.
   5) Where a minimum height of 8'-0" is unachievable, wall mounted luminaires will be utilized.

5. Support
   a. Support surface mount luminaires from building structure.
   b. Provide luminaires and/or luminaire outlet boxes with hangers to support luminaire weight.
   c. Rigid metallic pipe stems shall be utilized for the support of pendant mounted luminaires, unless otherwise noted.
   d. Stem hangers shall be equipped with aligner box covers or canopies so that stems hang vertically, irrespective of the angle of the surface they are mounted from.
   e. Wherever a luminaire or its hanger canopy is attached to a surface mounted outlet box, a finishing ring shall conceal the outlet box.
   f. Yokes, brackets and supplementary supporting members needed to mount luminaires to suitable ceiling members shall be furnished and installed by Contractor. Verify mounting hardware required prior to installation.
   g. In areas with seismic requirements, suspended or pendant mounted luminaires shall be able to swing 45 degrees in any direction without hitting an obstruction. In the event hitting an obstruction is unavoidable, guy wires will be used to secure the luminaire in place.
   h. Support surface mounted luminaires greater than 2 ft in length at a minimum of each additional 2 ft, or as recommended by manufacturer.
   i. Brace suspended luminaires installed near ducts or other constructions with solid pendants or threaded rods.
   j. Rigidly align continuous rows of luminaires.

6. Mounting and Enclosures
   a. Install flush mounted luminaires to eliminate light leakage.
   b. For luminaires mounted adjacent to insulation, provide barrier to prevent insulation from coming in contact with luminaire, unless luminaire is approved for installation in contact with such insulation.
   c. Provide approved fire rated enclosures around luminaires in fire rated ceilings.

7. Conduit and Wiring
   a. Wire for connections to lamp sockets and auxiliaries shall be suitable for temperature, current, and voltage conditions.
   b. Conduit shall be hidden from normal view in all possible cases. In public areas where surface mounted conduit must be used, contractor shall install conduit as unobtrusively as possible.
C. Lamps:
   1. Provide new lamps delivered in original manufacturer's cartons.
   2. Fluorescent, LED and metal halide lamps shall be energized continuously for not less than 100 hours for proper seasoning.

D. Grounding:
   1. Ground luminaires and metal poles according to Division 26 Section "Grounding and Bonding for Electrical Systems".
   2. Nonmetallic Poles:
      a. Ground metallic components of lighting unit and foundations. Connect luminaires to grounding system with #10 AWG conductor.

E. Spare Parts:
   1. Provide spare globes and guards, 1 for every 100 of each type and rating installed. Furnish at least one of each luminaire family. Furnish 2 pendent fixtures, (1) type 5 and (1) type 3 per level.
   2. Provide spare louvers and reflector cones, 1 for every 100 of each luminaire family. Furnish at least one of each type.
   3. Provide spare plastic diffusers and lenses, 1 for every 100 of each luminaire family and rating installed. Furnish at least one of each type.
   4. Provide 1% spare replaceable LED lamp modules for each primary fixture series type in Luminaire Schedule
      a. Spare LED lamp modules shall be delivered to Owner in new condition and in original packaging.
      b. Manufacturer and model number shall match those installed in the project's luminaires.
   5. Provide spare LED drivers, 1 for every 100 of each primary fixture series type and rating installed. Furnish at least one of each type.
      a. Manufacturer and model number shall match those installed in the project's luminaires.
   6. Provide 1% spare LED luminaires with non-replaceable lamp modules consisting of entire LED luminaire assembly and driver(s).
   7. Provide 10% additional cost for fixture count discrepancies. This should be used for budgetary purposes only with no additional cost to the Owner.

3.2 SUBSTANTIAL COMPLETION

A. Quality Control:
   1. At Date of Substantial Completion, replace lamps/LED modules/LED luminaires which are not operating properly.
   2. Replace any lamps used as worklights during construction phase.
   3. Protection wrapping on lensed or louvered luminaires shall be removed before installation of furniture, but after finish work is complete.
   4. Deliver spare equipment to Owner's representative.

B. Tests:
   1. Give advance notice of dates and times for field tests.
   2. Provide instruments to make and record test results.
   3. Verify normal operation of each luminaire after luminaires have been installed and circuits have been energized.
   4. Verify operation of luminaires with lighting control system and daylight harvesting systems. Any dimmed fixtures shall exhibit no signs of flickering.
5. Replace or repair malfunctioning luminaires and components, then retest. Repeat procedure until all units operate properly.
6. Report results of tests.

C. Adjusting and Cleaning:
1. Clean luminaires of handling marks, dust and dirt.
2. Cleaning and touch-up work shall be performed in accordance with luminaire manufacturer’s recommendations.
3. Damaged luminaires or components shall be replaced with new.
5. Program preset dimming system lighting levels.
6. Program ambient light sensors integral to luminaires for appropriate illumination levels as indicated in control narrative or in lighting control specifications.
7. Program occupancy sensors integral luminaires for appropriate time delay as indicated in control narrative or in lighting control specifications.
8. Exterior poles, bollards, bases and other exterior luminaires shall be painted to match factory color where finish has been damaged.
9. No light leaks shall be permitted at the ceiling line from any visible part or joint.

D. Training
1. Contractor shall provide owner with 3 complete copies of a set of Operations and Maintenance manuals.
   a. All “Approved as Noted” comments shall be corrected/picked-up in this record manual set.
   b. Each manual shall contain specific information pertaining to the equipment installed. Each manual shall contain at a minimum:
      1) Detailed as built shop drawings for all lighting equipment installed.
      2) Manufacturer’s product cut sheets for all equipment installed keyed by type as to as built drawings.
         a) Luminaires
         b) Control gear/ballasts/drivers
         c) Lamps
      3) Manufacturer’s complete installation instructions for all equipment installed keyed by type to as built drawings.
         a) Luminaires
         b) Control gear/ballasts/drivers
         c) Lamps
      4) Equipment maintenance requirements and schedules.
         a) Luminaires
         b) Control gear/ballasts/drivers
         c) Lamps/LEDs
      5) Equipment manufacturer contacts.
         a) Luminaires
         b) Control gear/ballasts/drivers
         c) Lamps/LED modules
      6) Equipment manufacturer warranties.
         a) Luminaires
         b) Control gear/ballasts/drivers
         c) Lamps/LED modules
2. Contractor shall provide qualified personnel onsite to provide a minimum of three days of training to Owner's representatives.

3. This training shall cover:
   a. Luminaire use and maintenance
   b. Architectural lighting system use and maintenance
   c. Group relamping cycles

END OF SECTION 26 5000