hdesigngroup
5039 S. National Ave.
Springfield, MO 65810

Specification Manual

Project 20-035

Public Works Heated Storage Addition

St. Charles, Missouri

ARCHITECT
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Springfield, Missouri 65810
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MEP ENGINEER
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9920 Watson Rd., Suite 201
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STRUCTURAL ENGINEER
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2225 W. Chesterfield Blvd.
Springfield, Missouri 65807
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CIVIL ENGINEER
Walter P. Moore
920 Main St., 10th Floor
Kansas City, Missouri 64105
phone: 816-701-2100

January 22, 2021

CIVIL

I hereby certify, pursuant to Section 327.411 RSMo Supp 2006, the documents intended to be authenticated by my signature are limited to:

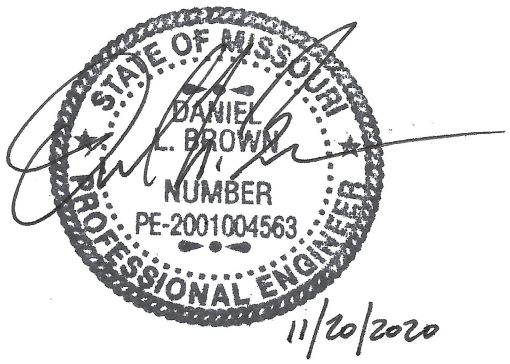
Specifications: Sections 311000, 312000, 321313 and 321373.

Drawing Sheets: C0.1, C1.2, C2.1, C3.0, and C4.0.

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project survey or landscape architectural project.

By: Walter P. Moore and Associates, Inc.

Daniel L. Brown, P.E.
Registered Professional Engineer
State of Missouri #PE-2001004563



STRUCTURAL

I hereby certify, pursuant to Section 327.411 RSMo Supp 2006, the documents intended to be authenticated by my signature are limited to:

Specifications: Sections 033000, 042200, 051200, 054000 and 133419

Drawing Sheets: S0.0, S0.1, S1.1, S2.2, S3.2 and S4.3

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project survey or landscape architectural project.

By: Mettemeyer Engineering, LLC

Alan R. Mettemeyer
Registered Engineer
State of Missouri #E-2000162147

ARCHITECTURAL

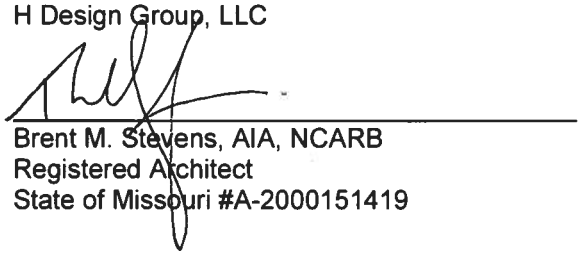
I hereby certify, pursuant to Section 327.411 RSMo Supp 2006, the documents intended to be authenticated by my signature are limited to:

Specifications: Sections 011000, 012500, 012600, 012700, 013100, 013200, 013300, 014000, 014200, 015000, 016000, 017300, 017419, 017700, 017823, 017839, 017900, 033000, 042200, 072100, 073100, 074114, 074213, 076200, 079200, 082550, 083600, 087100, 099123, 104416, 133419

Drawing Sheets: A1.2, A2.4, A3.1, A4.4, A5.4, A6.3, A6.4, A8.1

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project survey or landscape architectural project.

By: H Design Group, LLC



Brent M. Stevens, AIA, NCARB
Registered Architect
State of Missouri #A-2000151419

Electrical

I hereby certify, pursuant to Section 327.411 RSMo Supp 2006, the documents intended to be authenticated by my signature are limited to:

Specifications: Sections 260010, 260500, 260502, 260519, 260526, 260529, 260533, 260543, 260548, 260553, 260573, 260923, 262416, 262726, 262813, 262816, 265100, 265600, 270010, 270500, 271000, 271100, 271500, 280010, 280015, 280020, 281116, 281300, 282300, 283353, and 285000.

Drawing Sheets: E0.0, E0.1, E1.4, E2.4, E4.1, E5.1, E6.1 T0.0, T0.1, T1.3, T1.4, T2.1, T3.3, and T4.5.

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project survey or landscape architectural project.

By: Henderson Engineers

_____
Curtis Olds, P.E.
Registered Professional Engineer
State of Missouri #PE-2018066640

Jan 22 2021

Mechanical

I hereby certify, pursuant to Section 327.411 RSMo Supp 2006, the documents intended to be authenticated by my signature are limited to:

Specifications: Sections 210010, 210500, 210515, 210553, 211313, 220010, 220015, 220500, 220515, 220523, 220529, 220700, 221100, 221300, 227000, 230010, 230015, 230500, 230593, 230913, 233113, 233300, 233423, 233713, and 235500.

Drawing Sheets: M0.0, M1.4, M1.6, M1.10, P1.4, P2.4, P4.1, and P5.1.

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project survey or landscape architectural project.

By: Henderson Engineers

_____

Carl Holden, P.E.
Registered Professional Engineer
State of Missouri #PE-2018036640

Jan 22 2021

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PUBLIC WORKS HEATED STORAGE ADDITION
FOR CITY OF ST. CHARLES
20-035

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INVITATION TO BID
THE CITY OF ST. CHARLES, MISSOURI
BID 4520
ST. CHARLES PUBLIC WORKS FACILITY ADDITION

Notice is hereby given that The City of St. Charles will receive sealed bids clearly marked "BID 4520" on or before **2:00 P.M. City time, Tuesday February 16, 2021** to The City of St. Charles, Attn: Willie Hantack, 200 N. Second Street, St. Charles, MO 63301. There will be a public opening of the bids immediately following at the same location in room 102. Documents will be available January 25, 2021 at https://www.stcharlescitymo.gov/bids.aspx.

There will be one (1) bid package associated with this bid. Please reference the detailed scope of work narrative provided in the bid documents. The work would include providing the necessary labor, materials and equipment to construct associated sitework, construction of an addition to the existing Public Works Facility and various bid alternates as detailed in the plans and specifications provided with the bid documents.

Prospective general contractors and subcontractors are encouraged to attend the pre-bid meeting will be held on February 2, 2021 at 10:00 am CDT at the Public Works Facility, 2871 Elm Point Industrial Drive, St. Charles MO 63301 with a site walkthrough immediately following the meeting. Site address is immediately adjacent to the Public Works Facility

The City reserves the right to reject any and all submittals, or to advertise for new submittals if deemed necessary.

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St. Charles Public Works Facility Addition
Bid Package General Construction
Scope of Work

The Owner Representative (OR) referred to below is Navigate Building Solutions, LLC. The Owner referred to below is The City of St. Charles, MO. The Contractor referred to below is the General Works Contractor. This bid package includes, but is not limited to, the following:

All work outlined by the project documents (plans and specifications) issued by H Design Group (Architect) dated January 22, 2021.

Specifications: Division 00 all Sections; Division 01 all Sections; Division 03 through 28 all Sections; Division 31 through 33 all Sections; Civil & Landscaping work.

1. This contractor shall include in the base bid price a scope coordination and unforeseen conditions allowance of $50,000. Allowance shall include all overhead, profit, and fees as is allowed for Change Orders in specification section 01 2700 Contract Modification Procedures. Unit prices provided on the Bid Form shall be used where applicable to work paid from the Allowance. Any savings to this allowance shall be reconciled via a deduct Change Order which shall include the associated overhead, profit, and fees. This allowance may only be used at the sole discretion of the OR and Owner. This allowance may not be used to address the effects of weather conditions. Allowance amount to be entered on Bid Form.

2. Contractor is aware of the potential for damages. Contractor shall be responsible to maintain scheduled items for the Contractor's work as included in the project master schedule below. Contractor shall reference the sample contract drafts provided in the bid documents, Contractor agrees to pay the Owner, or to deduct from the Contract Sum, not as a penalty, but as damages, the amounts listed in the contract draft provided.

3. The sample contract draft has been provided. Contractor shall read and agree to these documents as part of the bid process.

4. Upon execution of this contract, this contractor must submit to the OR a detailed critical path baseline construction schedule outlining each construction activity and phase. This schedule must fall within the master project schedule outlined below and be submitted no later than twenty-one (21) days following execution of the contract. Contractor is required to provide updated work schedules on a weekly basis. Contractor's detailed activity schedule/critical path schedule shall adhere to the master project schedule. Should the Contractor fall behind schedule by more than 5 work days due to the fault of this Contractor, the Contractor shall provide a recovery schedule to the Owner Representative within 5 days of request by the Owner Representative.

Project Master Schedule/Milestone Dates:

Request for Bids issued	January 27, 2021
Pre-Bid Meeting	February 2, 2021 at 10:00am
Bid RFIs Due	February 5, 2021 at 5:00pm
Last Bid Addenda (if necessary)	February 9, 2021
Bids Due and Opening	February 16, 2021 at 2:00pm
Supplemental Bid Documents Due	February 17, 2021 at 2:00pm
Pre-Award Conferences	TBD, February 18 to 24, 2021
Council Approval of Contractor	March 2, 2021
Notice to Proceed (Day 1)	March 8, 2021
Mobilization/Pre-Construction	March 8, 2021
General Works Contractor Internal Pre-Punch	2 weeks prior to Substantial Completion
Sub. Completion/Punchlist Populated (Day _*)	* Based on Bidder's proposed duration.

All Life Safety Inspections and Occupancy Inspections to be completed on or before Substantial Completion date.

Substantial Completion shall be no later than September 1, 2021.

Final Completion / Completion of Punchlist	30 calendar days after Sub. Completion

Final Completion / Completion of Punchlist shall be no later than October 1, 2021.

5. The contractual project duration shall be proposed by bidders on the Bid Form. The proposed duration will be used as key criteria along with other information on the Bid Form to select and award a General Contractor. The project duration will be incorporated into the Contract between the Owner and the General Contractor.

6. Contractor accepts all risks associated with adverse weather. No time extensions will be granted related to claims of adverse weather. No claims for extra costs will be granted related to adverse weather and/or taking action to deal with adverse weather and/or the effects of adverse weather. All provisions in the sample contract agreement otherwise respecting weather are superseded by this provision, and are of no force and effect.

7. Any claims for delay to critical path activities shall be submitted to the Owner's Representative within 24 hours of occurrence, identifying the event and the impacted critical path activity. The

Owner's Representative will review to determine if the claim will be considered a valid delay. Each day claimed shall be tracked on a log for review at the bi-weekly Owner meetings.

8. Contractor is required to provide detailed work schedule (short term schedule) on a weekly basis. Contractor's detailed work schedule shall adhere to the Master Project Schedule and the accepted contractual project duration. Contractor shall meet the requirements of the Master Project Schedule.

9. Provide all supervision, labor, tools, equipment and materials to complete the work.

10. Perform all freight, unloading, loading, distribution and hoisting of materials.

11. Furnish, install, maintain and remove temporary on-site trailers and storage containers as required to perform the work. This contractor shall provide in the jobsite trailer a conference table and chairs for contractor weekly foreman meetings, bi-weekly Owner meetings, and other meetings as needed. Contractor shall provide shared use of office space or conference table in the trailer for use by the OR and Architect. Contractor shall provide use and access to a shared printer/scanner and WIFI service in the trailer to the OR and Architect.

12. Perform all work in accordance with OSHA standards and the Additional Project Safety Requirements issued in the specifications (including OSHA 10-hour requirement).

13. This Contractor (or its subcontractors) is responsible for all permits, if required and fees required by state, county, local, regional, and federal authorities and agencies associated with this scope of work. This Contractor is required to comply with all permit requirements and inspection requirements associated with such permits. This Contractor is also required to obtain a Business License from The City of St. Charles (if applicable).

14. This contractor (or its subcontractors) is responsible for all permits, if required and fees and tap/connection fees required by utility companies. Contractor shall also include the cost of the meters from the applicable utility companies.

15. Contractor to obtain fire alarm permit and fire sprinkler permit as required. Coordinate with Fire District and/or AHJ for inspection of fire lines and fire hydrants. Site fire line into the building shall be flushed prior to interior drywall partition construction.

16. Coordinate all work with the Owner Representative.

17. This contractor shall provide all layout required to complete the work included in this Contractor's scope of work.

18. Review all drawings and specifications and accept responsibility for requirements, general notes, notes, specifications, and details as they relate to this scope of work.

19. This Contractor will install, maintain, and remove all SWPPP procedures and silt fence for the project. Contractor will provide weekly and rain event SWPPP reports per MDNR standards.

20. All erosion control systems are inspected and corrected weekly, especially within 48 hours of any rainstorm resulting in one-half inch of rain or more. Any silt or debris leaving the site and affecting public rights-of-ways or storm water drainage facilities shall be cleaned up within 24 hours after the end of the storm. A SWPPP map/plan needs to be posted in the trailer and marked up as BMP's are installed/modified.

21. This Contractor is responsible for locating all public and private utilities.

22. Provide street cleaning to remove dirt, mud, and debris generated by the project site as needed to maintain a clean surface to existing adjacent parking lot and drives.

23. Provide adequate dust control during construction work, including misting during earthwork operations.

24. Provide barricades, signage, flagging and flagman for traffic control and public safety during the execution of the work. Coordination of all road closures (full or partial) with OR, City officials, and applicable authorities having jurisdiction (AHJ).

25. Protect adjacent properties and utilities as required during the execution of this work. Provide shoring or underpinning as required for safe excavations to meet OSHA requirements and to protect adjacent streets, sidewalks and utilities. If this requires engineered shoring systems, this Contractor will provide as needed for this scope of work.

26. This Contractor to cleanup all rubbish and debris from site and building on a daily basis. This includes off-site disposal of all rubbish and debris along with excess spoils, unsuitable materials, excess materials such as concrete, sand and masonry materials. Trucks or dumpsters to haul off material by this Contractor.

27. This Contractor shall furnish all dumpsters for the entire project and shall include cost to haul offsite and legally dispose of all construction rubbish and debris.

28. Bi-weekly meetings at the jobsite will be held with the Owner Representative. This contractor's Project Manager and Superintendent to coordinate installation of all systems. The work of this contractor must be performed in accordance with the decision and schedules formulated at these meetings so as not to delay the work. The Contractor's Project Manager and Foreman/Superintendent must be present at these meetings. This contractor shall keep minutes of these meetings and forward to the OR for review within 3 working days after the meeting.

29. A heavy construction cleaning shall be performed prior to punchlist creation so all surfaces can be observed by the design team. Provide final cleaning of all buildings and site prior to occupancy.

30. Weekly meetings at the jobsite MUST be held with this contractor and its subcontractor's Foreman/Project Managers to coordinate installation of all systems. The Owner and the OR shall be invited to all of these meetings and will attend at their discretion. This contractor shall keep minutes of these meetings and forward to the OR for review weekly.

31. This contractor will be responsible to review all specifications and drawings including Architectural, Civil, Mechanical, Plumbing Electrical, Fire Protection, Low Voltage, and Structural, etc. and will include all divisions of work in their proposal.

32. General Contractor and its HVAC, Plumbing, Fire Protection and Electrical subcontractors will be expected to coordinate above-ceiling work prior to installation, including the creation of drawing overlays to identify and address interferences prior to installation.

33. General Contractor shall provide all surveying and layout required to complete this work.

34. Take note of nearest water source and the schedule for water line installation; if not water is available on site, provide alternate means for tire wash down of trucks prior to leaving the site.

35. Contractor will provide ice, cups and distribute drinking water for the jobsite.

36. Provide temporary protection labor and material. Contractor to also install adequate temporary protection across any exposed concrete floors to eliminate staining or damage to finished floor product. Contractor to maintain this until all this contractor's work is complete along with MEPFP trades. Once all the work has been completed this contractor will remove and dispose of the temporary protection (at a minimum request use of masonite boards with the seams taped). Any damage to exposed floors that requires remediation prior to installation of finished surface will be at the expense and responsibility of this Contractor. This includes providing temporary entrances from adjacent existing structures and any necessary temporary construction partitions during renovation phases of work to barricade construction area and occupied spaces. Location of walls/entrances to be coordinated with the Owner & OR.

37. The Owner, Architect, and OR will be very stringent on the quality of exposed concrete floors during punch list. It is ultimately in this contractor's scope of work to protect all finish products through education, signage, and temporary protection. Proper concrete protection from staining must be observed and will be enforced. Steel must not be placed on slab to avoid staining. Diaper hydraulic power equipment to avoid oil and gasoline staining. Pipe cutting machines shall not be used on the concrete slabs where the exposed concrete finishes are scheduled. Any rubber-tired traffic shall be kept at a minimum and shall be protected with drop cloths.

38. Plan concrete floor pours such that a single pour covers any continuous are of exposed concrete or sealed concrete.

39. No lignite to be used in any flatwork concrete (interior and exterior).

40. Contractor to furnish first aid and safety supplies as needed.

41. Contractor is solely responsible for site/project safety.

42. Contractor to maintain proper SDS sheets for all materials utilized by this Contractor (and its subcontractors) in a central location on site per OSHA standards. Site Specific Safety Plan shall be completed and kept in the job trailer at all times.

43. Contractor to grout fill frames per architectural details and notes.

44. Provide code compliant seismic support and bracing as required for installation of MEPFP systems.

45. Provide Fire-Stop Systems as required for the installation of the work of this project. Fire-Stop Systems for floor and wall penetrations of all Mechanical, Plumbing, Electric and Fire Protection Systems must be included as well.

46. Provide stenciling of rated walls according to the AHJ requirements.

47. Contractor will provide temporary construction toilets for the project.

48. Contractor to provide and maintain weather protection for material and work as required by the project schedule. Contractor to also provide any cold or hot weather measures for weather sensitive materials like concrete, masonry, roofing materials, air/vapor barrier, etc. This shall include but is not limited to tenting and heating for masonry installation. Delays will not be awarded for construction activities impacted by hot/cold temperatures. If wet site conditions are hindering the progress onsite and access for trades, this Contractor shall provide temporary rock access to those areas to maintain the project schedule.

49. Include water pumping and dewatering necessary to proceed with work being performed under this bid package.

50. Once the framing of the building is complete, this contractor is responsible for securing the building with temporary or permanent measures at the close of every day. Any temporary openings in existing walls are to be secured at all times at the end of the work day.

51. This contractor to supply and install a temporary site fence and appropriate gates at the entrance to the site to ensure that the site is secured daily. At the construction trailers, temporary rock parking is required for visitors to the site, temporary construction parking, staging, and laydown

areas. Coordination of all staging/trailer placement/access to be coordinated and approved by the Owner. This contractor shall remove temporary site fence at substantial completion. All construction activities must take place inside of project site.

52. This Contractor is strictly prohibited from parking on adjacent property parking lots without written permission from property owner. Location of all staging / trailer placement / access to be coordinate and approved by the OR.

53. CONTRACTOR will be required and install/maintain a construction entrance/road. All construction traffic, deliveries, staging, etc. will be required to use this entrance. The gate at the entrance needs to be set far enough off the road that a semi-truck and trailer waiting for the gate to open will not block the public road, parking lot, or drive lanes.

54. General Contractor shall place rock around the building perimeter to create an all-weather access path for equipment access and exterior wall construction.

55. Contractor responsible for any coordination of staging or relocation for materials after initial unloading.

56. Contractor to coordinate all deliveries of materials with Owner Representative's personnel.

57. This contractor to broom clean all floors at least once a week to ensure housekeeping stays up to par.

58. As-built Surveys will be required by this contractor at the Completion of the Project, including for Site Utilities, rain gardens, detention basins, etc. to submit to Utility company or City/County for final approval.

59. Testing shall be performed by and paid for by Owner. Contractor will assist and coordinate testing/inspections as needed to maintain the schedule. Contractor will assist and coordinate/schedule with the agency to perform onsite testing work as needed/required by the documents. If the agency must re-test or re-inspect for failed tests/inspections or if the Contractor fails to notify the testing agency of a cancelled test/inspection, this Contractor shall compensate the Owner for such tests.

60. Include ALL caulking and sealants for all systems and materials furnished and installed on the bid documents.

61. No tobacco use is allowed on the project nor on site.

62. This Contractor to supply and install all site storm piping and downspout connections. Contractor to coordinate site, plumbing, and architectural drawings.

63. This Contractor to supply and install all site utilities indicated as new on the project documents. The contractor is responsible for all meter costs as a part of the project.

64. Full-time onsite superintendent is required when any of this Contractor's labor or this Contractor's subcontractors labor is onsite.

65. Contractor shall use Procore Project Management software program or OR approved alternative for coordination of project RFIs, submittals, change orders, etc. Contractor shall be the administrator and maintain all records in the program, and shall grant access to the Owner, OR, and design team members. Included the cost associated with the use of such program in bid.

66. Contractor shall submit all submittals for Architect review within the first 60 days, or sooner as needed to meet the overall project schedule for installation of the work. Submittals that are not approved by the Architect which require resubmittal do not constitute a schedule delay.

67. This contractor shall produce a submittal log at the beginning of the project that is populated with all of the required submittals for the project and assign due dates for submission to the Architect and due dates for return from the Architect. This log must be submitted to the OR and Architect for review on a weekly basis.

68. This contractor shall maintain a RFI log for the project indicating the following. This log must be submitted to the OR and Architect for review on a weekly basis.

    Topic of RFI

    Date submitted

    Date requested response by

Date returned

Status- Open or Closed

69. Immediately upon award this contractor shall submit a proposed site logistics plan for review. The Owner, OR, contractor, and Architect will meet to review and discuss site logistics and finalize an agreed upon plan of action for construction parking, office/storage containers, temporary toilets, temporary site fence, etc.

70. This contractor must prepare and make available upon request, a procurement log for all long lead materials and equipment. Procurement log must include date of order, date of confirmation of order, expected delivery date, actual delivery date, and comments noting any changes to dates and reasons for change.

71. This contractor shall organize and arrange for pre-installation meetings for all major scopes of work with the subcontractors and manufacturers prior to commencement of those activities and invite the Owner, Architect, and OR to all pre-installation meetings. This contractor shall keep minutes of those meetings and forward to the OR and Architect for review.

72. This contractor will be responsible for submitting daily logs containing the number of workers, equipment, work accomplished, daily weather, deliveries, visitors to the site, any inspections passed or failed, problems encountered, and other relevant data as may be required. Daily logs are required to have a minimum of 6 pictures attached each day. These reports must be emailed to the OR daily utilizing an Apple iPad app called Construction Superintendent and issued to the Owner Representative within 24 hours of work performance.

73. OR must be contacted prior to cover-up of all rough-in so that photographs can be taken for Owner's record if desired.

74. Provide photographs of all below slab, in slab, and in-wall rough in. Organize photos electronically and label with location. Submit 'rough in photograph' package at the end of the project. OR may ask for progress photos during project as needed for reference or coordination.

75. This contractor shall arrange, schedule, organize and video tape all equipment start-ups and Owner Training sessions. The camera requirements should include at minimum a SDR camera with external microphone and tripod. Equipment manufacturer reps should be present at start-ups and trainings and Owner and OR should be notified of all training sessions. At the completion of

the Owner Training sessions, this Contractor will organize the videos neatly into chapters and provide (3) copies to the Owner in the form of DVD. It is recommended that this service be contracted with a professional videographer.

76. This contractor must populate a closeout log and submit to the OR and Architect for review to verify that all required items have been populated. Once approved, this log will be used to track required closeout items prior to final payment. This contractor is highly encouraged to submit O&M requirements as soon as possible in advance of final acceptance to help eliminate delay in payment.

77. If this contractor chooses to backfill foundation walls prior to that time which is approved/allowed by the structural engineer, this contractor is responsible for designing, installing, rental (and eventual removal) of all temporary shoring of foundation walls prior to backfill (i.e.: if walls are not designed as structural retaining walls; verify with design engineer).

78. This contractor is responsible for any temporary heating/cooling, humidifying/dehumidifying as needed to maintain the project schedule and as needed prior to starting the permanent HVAC equipment. Use of the new HVAC system will not be allowed during construction.

79. This Contractor shall be responsible for the cost of temporary utilities during the course of construction i.e. but not limited to: gas, electric, sewer, water. If there is only single phase electric available from the local electric utility for temporary electric, any other needs will require the use of a temporary generator at the contractor's cost. Contractor is responsible for all backflow preventer costs / water usage costs for hydrant use.

80. Contractor shall coordinate, furnish, and install temporary transformer according to the electric utility requirements.

81. Contractor shall clean all HVAC equipment and replace all filters with new filters at the time of building turnover to the Owner.

82. All ductwork ends to be sealed before arriving at the site and seals at the end of runs to be maintained. All temporary seals shall be removed prior to startup of equipment.

83. This contractor will compile for the Owner a 'record set' of all documents and drawings for the project at substantial completion. This shall be 'red-lined' copies of all project changes throughout the course of the project to identify all systems as they were actually installed on the project for the Owner's records. These must be electronically recorded (electronically modified documents - not scanned markups)and submitted to the Owner in pdf format on a 'thumb drive'.

84. Contractor is required to hold their alternate pricing that was included in the bid form for 3 months after the bid date. Contractor will notify Owner Representative when decisions need to be made regarding the acceptance of bid alternates in order to maintain deliveries, installation, and the master project schedule.

85. Construction work shall only be allowed during the following hours:

    6AM – 6PM (Monday thru Friday) Anytime outside these hours needs to be pre-approved by The City of St. Charles.

86. Stabilization measures must be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.

87. The CONTRACTOR shall provide one project sign. The sign will include the Owner's logo, design team logos, owner rep logo and the CONTRACTOR logo. They shall also include the project name and expected completion timeframe. No other project signs will be allowed on the project for advertisement. The sign needs to a minimum of 4' by 8. The sign will be installed off the main roads and maintained throughout the project. Location to be approved by the Owner.

88. During the warranty period of the project, this Contractor shall document, maintain and update a Warranty Log of all warranty items, weekly, to be shared with the Client and Owner Representative. Contractor shall acknowledge the Owner's warranty call within 4 hours and keep the Owner apprised of the resolution status. Any roof or building envelope leaks or any issue that interferes with regular building operations shall be considered as urgent / emergencies. Contractor to provide a 24-hour on-call service for such urgent or emergency items.

89. Builder's Risk to be carried by the Contractor. Deductibles to be paid by the Contractor.

90. No change orders will be issued for material cost increases or impacts of tariffs that occur during the project.

91. Contractor is required to maintain access to the work as needed to maintain schedule. Schedule delays will not be accepted for wet/poor site conditions after weather events.

92. Contractor should incorporate COVID-19 safety planning and worksite-specific safety practices in to the Site Specific Safety Plan. Contractor should continually evaluate the specific risks associated with a particular job site based on guidance from the Centers for Disease Control and Prevention (CDC) and the Federal Occupational Safety and Health Administration (OSHA).

93. The Contractor schedule shall include all work propose in the Bid Alternates. No time extensions will be granted for accepted Alternates.

94. Unit prices provided on the Bid Form and incorporated into the contract shall apply to the condition described in the unit price, regardless of which subcontractor performs the work or when the work is being performed.

95. Contractor shall provide housekeeping pads.

96. Proof roll subgrade prior to placing base rock for paving.

97. Asphalt lifts shall be not greater than 3” thick.

98. Provide site bollards compete with footing, anchoring, concrete fill, painting, and plastic covers.

99. Contractor is responsible for all rock excavation and removal as required at footings, foundations, under slab rough in, and site utilities as recommended by geotechnical report. Contractor shall include expansive clay remediation below the building pad and all footings per recommendations in the geotechnical report. All remediation required during the course of the construction that is in excess of or less than the recommendations made in geotechnical report will be compensated or deducted at unit cost rates submitted by the Contractor supplemental bid form. Such work quantities must be tracked by the Contractor and confirmed by the Owner’s Materials Testing agency. No time extensions will be granted for soil remediation taking place under the base bid.

100. No change orders will be awarded for additional forming or additional concrete in over excavated footings.

101. All areas must be left at the end of each day so that there is no standing water. Grade temporary swales to drain site, if necessary, to achieve this requirement.

102. Strip topsoil, stockpile, and stabilize until ready for use. Spread topsoil to the depth required by civil and landscape drawings and specifications.

103. Pressure test and chlorinate site water lines. Provide test reports to Owner verifying acceptable pressures and chlorination. Coordinate with utility company / fire district and obtain approval from those parties as required.

104. Provide access panels needed for all work installed under this contract.

105. Contractor must include Professional Liability and errors and omissions insurance for the delegated design scopes of work that are required by the specifications to be designed by a professional engineer. Drawings and calculations shall be signed and sealed by a Professional Engineer registered and in good standing in the State of Missouri.

END OF SECTION

SCI ENGINEERING, INC.
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St. Charles, Missouri 63301
636-949-8200 Fax 636-949-8269
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Geotechnical Report

CITY OF SAINT CHARLES – NEW PUBLIC WORKS FACILITY
SAINT CHARLES, MISSOURI

June 2013

CITY OF SAINT CHARLES
Owner

H DESIGN ARCHITECTURE
Architect

WALTER P. MOORE
Civil/Structural Engineer

PREMIERE CIVIL ENGINEERING
Surveyor/Civil Engineer

SCI No. 2013-0394.10

SCI ENGINEERING, INC.

CONSULTANTS IN DEVELOPMENT,
DESIGN AND CONSTRUCTION
GEOTECHNICAL
ENVIRONMENTAL
NATURAL RESOURCES
CULTURAL RESOURCES
CONSTRUCTION SERVICES

June 20, 2013

Mr. John C. Zimmerman, P.E.
Assistant Director of Public Works
City of Saint Charles
200 North Second Street
Saint Charles, Missouri 63301

RE: Geotechnical Report
City of Saint Charles – New Public Works Facility
Saint Charles, Missouri
SCI No. 2013-0394.10

Dear Mr. Zimmerman:

Attached is our *Geotechnical Report*, dated June 2013. It should be read in its entirety, and our recommendations applied to the design and construction of the project. Selected excerpts from the report are highlighted below:

- Based on the soils encountered in the borings, shallow spread footing foundations may be designed for maximum net allowable soil bearing pressures of 1,800 pounds per square foot (psf) for strip footings and 2,200 psf for column footings, as discussed in the report.

- The fat clay soils will require remediation if present within 3 feet of the bottom of the floor slab or 2 feet beneath the footings.

- Infiltration testing was performed within the two water quality basins and resulted in infiltration rates of 0.0 inches per hour.

- Based on the soils encountered and the anticipated depth to bedrock, Site Class D should be used for foundation design, with site coefficients F_a of 1.44 and F_v of 2.23 for short periods (S_s) and 1-second periods (S_1), respectively.

- Global stability analysis of retaining walls may, depending on the wall locations, configurations, and heights may need to be performed before SCI can seal project drawings.

We appreciate the opportunity to be of service, and look forward to working with you during the construction phase of the project. SCI should participate in a meeting prior to clearing/grading of the site. Such meetings are valuable in reviewing and clarifying project requirements and responsibilities.

If you have any questions or comments, please call.

Respectfully,

SCI ENGINEERING, INC.

Shawnpa L. Erter, P.E.
Senior Engineer/Associate

SLE/krm

Enclosure
Geotechnical Report

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Geotechnical Report

CITY OF SAINT CHARLES – NEW PUBLIC WORKS FACILITY
SAINT CHARLES, MISSOURI

1.0 INTRODUCTION

At the request of Mr. John C. Zimmerman, P.E., Assistant Director of Public Works for the City of Saint Charles, SCI Engineering, Inc. (SCI) conducted a geotechnical exploration for the proposed public works facility. The purpose of our exploration was to characterize and evaluate the subsurface conditions, provide recommendations for foundations, and address other geotechnical aspects. Our services were provided in general accordance with our proposal dated May 9, 2013 as authorized by Mr. Zimmerman.

2.0 SITE AND PROJECT DESCRIPTION

We understand that multiple structures as well as a water quality basin, pavements and yard storage are currently being planned for a site located at the Elm Point Industrial Park in Saint Charles, Missouri. The location of the site is shown on the *Vicinity and Topographic Map*, Figure 1. We understand that the Public Works Building will consist of a single story steel framed or pre-engineered metal building with metal panel cladding. The Fleet Services Building consists of a single story steel framed or pre-engineered metal building with some masonry cladding and some metal panel cladding. The proposed construction is shown on the *Site Plan*, Figure 2.

We anticipate that the Public Works Building will be lightly loaded structure with a maximum interior column reaction of 30 kips and a maximum exterior footing line load of 2.0 kips/foot. The Fleet Services Building will be lightly loaded with a maximum column reaction of 60 kips and a maximum exterior footing line load of 3.0 kips/foot.

SCI have reviewed the geotechnical explorations performed by SCI in the vicinity of this project, including the Old Dominion Freight Line Shop, Elm Point Storage Condos, Glazer's Office and Distribution Center, and Coca Cola. We have not reviewed, nor are we aware of, any previous studies on this specific site, by SCI or others, that would affect the preparation of this report.

3.0 SUBSURFACE CONDITIONS

A total of sixteen borings were drilled at the approximate locations shown on the *Site Plan*. Detailed information regarding the nature and thickness of the soils encountered, and the results of the field sampling and laboratory testing are shown on the Borings Logs in Appendix A.

The boring locations were staked in the field and ground surface elevations at the boring locations were provided by Premiere Civil Engineering**.**

Fat clay (CH in accordance with the Unified Soil Classification System and ASTM D 2488-06) was typically encountered from the ground surface to the depth of boring termination. However, existing fill consisting of lean and fat clay was encountered to depths of 2 to 3 feet in B-10 through B-12. Thin layers of natural lean clay were encountered at the ground surface in B-2 and B-16 as well as at a depth of 27 feet in B-2 and B-10.

Documented geology, including the Bedrock Geologic Map of the St. Louis Quadrangle, Missouri and Illinois indicates that geology at the site consists of the Alluvium. The Alluvium consists of gravel, sand, and silt deposits associated with flood plain deposits. These deposits are typically on the order of 100 feet thick in this area.

Groundwater was observed at depths of 5 to 18 feet during drilling. The groundwater level depends on seasonal and climatic variations, and may be present at different depths in the future. In addition, without extended periods of observation, accurate groundwater level measurements may not be possible, particularly in low permeability soils. We do not anticipate that groundwater will influence the construction of building foundations.

4.0 DESIGN RECOMMENDATIONS

4.1 Shallow Foundations

Shallow spread footing foundations bearing in undisturbed, natural, low plastic silty clay; remediated high plastic clay; or newly placed low plastic structural fill are appropriate for support of the proposed addition. Based on the soils encountered during our exploration, shallow foundations can be sized for maximum net allowable bearing pressures of 1,800 pounds per square foot (psf) for continuous wall footings and 2,200 psf for isolated column footings. We anticipate that some localized areas of inadequate bearing materials may be encountered during construction; therefore, we recommend that an allowance be made in the construction budget for selected footing overexcavations.

Exterior footings and foundations in unheated areas of the buildings should be provided with at least 30 inches of soil cover for frost protection. Interior footings in heated areas can be located at nominal depths below the finished floor. For footings designed and constructed in accordance with our recommendations, total settlement should be less than 1 inch, and differential settlement between adjacent footings should be less than ¾ inch.

4.2 Seismic Considerations

Ground shaking at the foundation of structures and liquefaction of the soil under the foundation are the principle seismic hazards to be considered in design of earthquake-resistant structures. Liquefaction occurs when a rapid buildup in water pressure, caused by the ground motion, pushes sand particles apart, resulting in a loss of strength and later densification as the water pressure dissipates. This loss of strength can cause bearing capacity failure while the densification can cause excessive settlement. Potential earthquake damage can be mitigated by structural and/or geotechnical measures or procedures common to earthquake resistant design.

4.2.1 Design Earthquake

According to International Building Code (2006 edition) (IBC 2006), structures such as those proposed for this project are required to be designed to a design earthquake with a 2 percent Probability of Exceedance (PE) over a 50 year exposure period (i.e. a 2,475-year design earthquake). The design earthquake has a Moment Magnitude (Mw) of 6.2 and a Peak Ground Acceleration (PGA) of 0.22g, as determined from data provided by the IBC 2006 and the United States Geological Survey (USGS) National Seismic Hazard Mapping Project.

4.2.2 International Building Code Site Classification

Based on procedures outlined in the IBC 2006 and our geotechnical explorations for the subject site, including the borings through predominantly medium stiff to stiff cohesive soil and the estimated depth to bedrock, the site can be classified as Site Class D for foundation design. Using the procedures outlined in Section 1613.1 of the IBC 2006, the calculated weighted average undrained shear strength (su) is in excess of the 1,000 psf required to be classified as Site Class D. Seismic design parameters for the site are as follows: $F_a = 1.44$, $F_v = 2.23$, $S_{DS} = 0.43$ and $S_{D1} = 0.21$.

4.2.3 Liquefaction Potential Analysis

The liquefaction potential analysis for the site was conducted using data from the field exploration and laboratory test results and the techniques outlined in the National Center for Earthquake Engineering (NCEER) Technical Report NCEER-97-0022. Based on our analyses, the soils at the project site have sufficient strength values to resist liquefaction during the design earthquake. While the amount of the seismically induced settlement is dependent on the magnitude and distance from the seismic event, we estimate that the settlements from the design earthquake will be negligible and relatively uniform in nature so liquefaction mitigation techniques are not required.

4.3 Floor Slabs

We recommend that the floor slabs be designed using a modulus of subgrade reaction (k) of 150 pounds per square inch per inch of deflection (pci) if bearing on lean clay or remediated fat clay. Floor slabs should be supported on a minimum 4-inch-thick layer of crushed stone. This will help to distribute concentrated loads and equalize moisture conditions beneath the slab.

It is generally preferable to maintain structural separation between the floor slab and the foundation walls and column pads using isolation joints. We also suggest that joints be placed in the floor slabs on no more than 15-foot intervals in any direction. Such joints permit slight movements of the independent elements and help reduce random cracking that might otherwise be caused by restraint of shrinkage, slight rotations, heave, or settlement.

We recommend that 6-mil-thick polyethylene sheeting be placed immediately beneath the floor slab and above the crushed rock or gravel, to reduce the transfer of capillary moisture to the slab. However, without careful attention to curing of the floor slab, the polyethylene sheeting can cause excessive shrinkage cracking and "curling."

4.4 Expansive Clay Remediation

Fat clay was encountered throughout the site. We anticipate that remediation of the fat clay soils will be required. Where the bearing soils consist of fat clay, we recommend that they be removed to minimum depths of 2 feet beneath the bearing level of the footings and 3 feet beneath the bottom of the floor slab. The overexcavation should extend at least 2 feet beyond the outside edge of the footings and building footprint to facilitate uniform compaction of the replacement materials, and may require additional widening at the building corners to allow equipment access for proper compaction. The overexcavation should be backfilled with properly compacted low plastic soil or 1-inch minus crushed limestone. As an alternate, the footing overexcavation may be backfilled with lean concrete. With this option, widening of the footing excavation is not required. If clean rock is used as backfill material, it must be drained to daylight or to a sump with a pump. The footings and floor slab would then be constructed on the newly placed fill.

As an alternative to overexcavation and replacement, the high plastic clay may be remediated by the addition of lime in combination with a recompaction operation. If lime stabilization is performed, we recommend thoroughly mixing in "Code L" (a locally available calcium oxide by-product also known as lime kiln dust) at a rate of 7 percent, or approximately 8 pounds of Code L per cubic foot of soil, to the

depths and lateral limits described in the preceding paragraph. Water may need to be added during mixing to allow for proper hydration of the lime. Pulverizing and tilling equipment, such as "gators," are preferred for mixing the lime into the soil. The treated soil should be placed in compacted lifts as discussed in the "Fill Materials and Compaction" section.

The methods of treatment described above are based on generally accepted standards in the local engineering community; however, swell pressures and volume change potential greater than can be mitigated by these methods may exist. Consequently, the owner should recognize that there is an inherent, but reduced risk that foundation and floor slab damage may occur, even after remedial treatment of the subgrade soil.

4.5 Below-Grade Walls

Below-grade walls required at this site may include retaining walls designed to accommodate surface grade changes around the building and paved areas. The maximum toe pressure for below-grade walls should not exceed the bearing pressure previously given for continuous strip footings. Retaining walls may be designed with an allowable coefficient of friction between the base of the concrete footing and the soil subgrade of 0.3.

Below-grade walls should also be designed to withstand lateral earth pressures caused by the weight of the backfill, including slopes behind the walls; and any surcharge, such as adjacent floor loads. We recommend the equivalent fluid unit weights tabulated below for lateral earth pressures, in pounds per cubic foot (pcf), be used in the design of below-grade walls. The indicated values assume that positive drainage is provided to prevent buildup of hydrostatic pressure. High plastic soils should not be used to backfill the wall excavations. Values for granular material should only be used if the granular backfill extends upwards and outwards the full height of the wall at a slope of 45 degrees or flatter from its base. In this case, exterior granular backfill should be capped with approximately 2 feet of cohesive soil to reduce the potential for surface water infiltration into the granular backfill. With clean granular backfill, filter fabric, such as Mirafi 140N, should be placed along the interface between the soil and granular backfill to reduce the potential for infiltration of the soil into the granular material.

Table 4.1 - Recommended Lateral Earth Pressures

Backfill Type	Equivalent Fluid Unit Weights	
	At-Rest Earth Pressures (pcf)	Active Earth Pressures (pcf)
Cohesive Soil	70	50
Granular Material (1-inch minus)	60	40
Free-Draining Granular Material (1-inch clean)	50	30

At-rest earth pressures should be used for restrained or fixed-headed walls that are restricted from rotation, such as loading dock or basement walls connected to floor joists or beams, or a wing wall attached to a basement wall. Active earth pressures should be used for free-headed walls where the base remains fixed and deflection at the top of the wall of approximately 1 inch for each 10 feet of wall height is allowed, such as a retaining wall.

The above values are applicable when the surface of the backfill behind the wall is horizontal. Upward sloped or loaded backfill will result in increased values. In addition to lateral earth pressures, below-grade walls should be designed to resist any surcharge loads, including shallow building foundations and traffic. These surface loads can be modeled as uniform lateral loads, equivalent to one-half of the surface load, acting at the halfway point on the wall.

A passive soil resistance modeled by an equivalent fluid unit weight of 250 pcf may be used for natural soil against the face of the exterior base or a key below the base of the wall. The upper 2 feet of soil backfilled against the exterior face of the walls and uncontrolled backfill soils should be ignored when calculating the lateral resistance. Lower passive pressure should be used if the ground surface slopes downward away from the face of the wall.

We recommend that all below-grade walls be provided with a drainage system. A minimum 4-inch diameter, perforated drainpipe should be used, and placed at foundation level. Granular drainage material, consisting of 1-inch clean crushed rock, classified as GP by ASTM D 2487, with less than 5 percent of the rock passing the No. 200 sieve, should be placed a minimum of 6 inches in all directions around the drainage pipe. Synthetic filter fabric, such as Mirafi 140N or equivalent, should encapsulate the drainpipe and granular drainage material. The pipe should be sloped to drain by gravity or through weepholes located on approximately 10-foot centers for above-grade retaining walls, or to a sump with a pump for below-grade walls where positive drainage by gravity cannot be achieved. Alternately, drainage can be provided directly through the weepholes without a drain pipe, provided that filter fabric is used or

other measures are taken to prevent the granular backfill from migrating out through the weepholes. Any interior sumps must be isolated "watertight" from the interior subgrade to prevent the movement of moisture from the sump into the underlying soils.

When information is available regarding specific wall locations, configurations, and heights, SCI should be retained to evaluate global stability, based on developed strength parameters for the subsurface soils and backfill. At your request, we can provide the global stability study, or we can work with your wall designer to provide coordinated internal and global stability studies. These services are beyond our current scope.

4.6 Site Grading and Drainage

Positive site drainage should be provided to reduce surface water infiltration around the perimeter of the buildings and beneath the floor slabs. All grades should be sloped away from the buildings. Roof and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill of the buildings.

Large trees and shrubs should be planted away from exterior footings as they may cause drying and shrinkage of the foundation soils and, with the passage of time, potentially detrimental settlement of the building floor slabs and foundations. A minimum distance of 20 feet or the mature tree's dripline, whichever is greater, is suggested.

We recommend that all final slopes have a maximum inclination of 3 horizontal to 1 vertical (3H:1V), and that a crest of at least 10 feet in width or a distance equivalent to the total height of the slope, whichever is less, be provided around the building before the surface slopes down and away. Cut slopes of less than 15 feet in total height and properly compacted fill slopes up to about 25 feet in total height should perform satisfactorily at this inclination, or flatter. We do not anticipate that steeper or taller slopes will be required. However, if they are proposed, the slopes should be brought to our attention and individually addressed and evaluated by SCI on a case-by-case basis.

4.7 Underground Utilities

Underground utilities can provide a pathway for water to migrate below the floor slab. Drain and utility pipes beneath floors should have tight joints to prevent leakage. If utility excavations are backfilled with free-draining granular materials, then cutoffs should be provided at the exterior walls to reduce the potential for water to migrate beneath the building. Impermeable cutoffs may consist of a 3-foot-long "plug" of cohesive soil or bentonite soil mix, or a 1-foot-long plug of lean concrete. Soil may be used for the balance of the backfill.

With the exception of individual service lines to the buildings that intersect foundations perpendicularly, below-grade utilities should not be located within the stress influence zone of the building foundations. Accordingly, below-grade utilities should be located outside a zone extending 45 degrees downward and outward from the edge of the footings.

4.8 Water Quality Basins

Although grading plans have not been developed, water quality basins will be required. The upstream and downstream slopes of the basin embankments should be no steeper than 3 horizontal to 1 vertical (3H:1V). We recommend that the crest be at least 8 feet wide to provide access for maintenance. The entire embankment should consist of cohesive soils with a plasticity index (PI) of at least 20. The fat clay encountered on site is suitable for construction of the detention basin embankments. Rocky or organic soils or high silt-content soils are not suitable for the construction of stormwater detention basin embankments because of their potential for erosion and piping.

Rock bedding should not be used for the outlet piping of the water quality basin. Instead, the outlet pipe should be placed on a cohesive soil subgrade, shaped to fit the pipe barrel, and the trench backfilled with properly compacted cohesive soil. Alternately, the trench can be backfilled to the springline of the pipe with lean concrete or flowable fill. Concrete anti-seepage collars should also be used to reduce seepage around the pipe.

4.9 Infiltration Tests

Two infiltration tests (B-15 and B-16) were conducted at the general locations shown on the *Site Plan* to assess the suitability of the soils within the proposed water quality basins. The testing was conducted in general accordance with Appendix D.1 of Maryland Stormwater Design Manual, dated October 2000. The results of the infiltration testing indicate an infiltration rate 0.0 inches per hour (in/hr) at both basin locations.

In general, the near surface soils encountered consisted of natural fat clay soils. As evidenced by the lack of infiltration, the natural soils are relatively impermeable. Therefore, installation of underdrains will be required in each water quality basin as the minimum required infiltration rate of 0.52 in/hr, as specified by the Maryland Stormwater Design Manual, was not met at each test location.

4.10 Pavements

Selection of the pavement section is dependent on the design life, traffic loads, subgrade strength, drainage characteristics, and the desired level of maintenance. Neither CBR testing nor formal pavement design was a part of our scope for this project. However, for planning purposes, the following recommendations typically result in pavements that perform satisfactorily on similar subgrades under automobile and pickup truck loads**.** They are intended to roughly provide a pavement requiring routine maintenance for a 5-year period, minor repair and maintenance during the 5- to 10-year life of the pavement, and possibly major repairs and restoration after a 10-year service life.

A flexible pavement section may be used for the parking lot and driveways. Parking areas for automobiles and light trucks should consist of a minimum 6-inch-thick crushed stone base with a minimum 3-inch-thick asphaltic concrete wearing surface. The crushed stone base should be thickened to at least 8 inches in drive areas. Care should be taken to provide drains or drainable transition at locations where pavement sections of varying thickness abut, so as not to trap water within the crushed stone base, which could saturate and soften the subgrade.

Alternately, a rigid concrete pavement section may be used, with less anticipated long-term maintenance. Parking areas for automobiles and light trucks should consist of a minimum 6-inch-thick, non-reinforced concrete pavement. Crushed stone base is not required under this light-duty pavement section. For more heavily trafficked areas, we recommend that the section consist of an 8-inch-thick, non-reinforced concrete pavement, over 4 inches of compacted base rock. This concrete pavement section should also be used to support concentrated wheel loads for trash dumpster pads, approaches, and other areas where trucks will maneuver. To provide resistance against salt and freeze-thaw cycles, we recommend the concrete have a minimum 28-day compressive strength of 4,000 pounds per square inch (psi) and air entrainment of 5 to 7 percent by volume. We also recommend that the maximum joint spacing be approximately 15 feet.

The existing fat clay will cause some heave distress in the pavement. To reduce long-term maintenance, consideration could be given to remediating the upper 18 inches of subgrade. Alternatives include removal and replacement with crushed stone or low plastic soil, or lime treatment. However, proper construction, along with periodic patching and overlaying, are likely more economical than remediation of the high plastic clay.

5.0 SITE DEVELOPMENT AND CONSTRUCTION CONSIDERATIONS

5.1 Site Preparation

Within the construction area, existing structures and related below-grade components to be abandoned must be properly demolished and the debris removed from the site. As an exception, deep utilities may be grouted in place rather than being removed. However, the existing backfill associated with deep utilities should be removed and replaced or recompacted. Outside this area, existing foundation walls and footings deeper than 3 feet below the proposed subgrade may be left in place. Excavations resulting from the removal of existing site improvements should be backfilled with properly compacted fill.

Areas to be cut or to receive fill should be stripped of any surface vegetation or organic topsoil. The strippings should be removed and stockpiled for later placement in landscaped or common ground areas, as appropriate. Topsoil can be reused as fill, if thoroughly mixed with other, acceptable, non-organic fill materials, as approved by SCI.

After stripping, the site should be proofrolled by systematically passing over the subgrade to achieve complete coverage with proper compaction or loaded construction equipment, and observing the subgrade for pockets of excessively soft, wet, or disturbed soil, or otherwise unacceptable materials. Soft areas or otherwise unacceptable materials, if encountered, should be removed and replaced with structural fill or stabilized prior to placing additional fill. If removal of soft soils is impractical due to their excessive depth, they should be stabilized or "bridged over" in a manner approved by SCI.

Soft soils will be encountered in the lower-lying areas of the site. If organic or soft areas are encountered, they should be removed and replaced with properly compacted fill or otherwise stabilized as approved by SCI. "Bridging" of the soft soils can often be accomplished by working 2- to 4-inch clean crushed rock into the softer soils and then placing a geofabric, such as Mirafi 600X or equivalent, prior to placing additional fill.

Natural slopes to receive fill which are steeper than 5H:1V should be benched prior to the placement of fill. Benching will provide level surfaces for compaction and reduce the potential for development of inclined planes of weakness between the natural soil and compacted fill. The benches should be spaced such that the height of the cut at the up-slope end of the bench is less than 5 feet.

5.2 Fill Materials and Compaction

Prior to fill placement and compaction, the upper 8 inches of the exposed subgrade should be scarified, moisture conditioned, and recompacted. Structural fill should be placed in maximum 8-inch-thick loose lifts and mechanically compacted to at least 90 percent of its modified Proctor maximum dry density (ASTM D 1557). Aggregate base course should be compacted to at least 95 percent modified Proctor. We recommend that any fill placed in building areas have a liquid limit less than 45 and a plasticity index less than 25. If higher plasticity soils are placed within 3 feet of the floor slab subgrade, or 2 feet of the bottom of the footings, then remediation will be required. Acceptable non-organic fill soils include materials designated CL, ML, CL-ML, SP, SW, GP, and GW by ASTM D 2487.

Prior to compaction, the soil may require moisture adjustment. During warm weather, moisture reduction can generally be accomplished by disking or otherwise aerating the soil. When air drying is not feasible, a moisture reducing chemical additive, such as hydrated lime, could be incorporated into the soil. During dry weather, some addition of moisture may be required to facilitate compaction. This should also be done in a controlled manner using a tank truck with a spray bar. The moistened soil should be thoroughly blended with a disk or pulverizer to produce a uniform moisture content. If construction is performed during the winter season, fill materials should be carefully observed to see that no frozen soil is placed as fill or remains in the base materials upon which fill is placed.

Backfill for foundation walls and retaining walls may consist of low plastic silty clay or 1-inch minus crushed limestone. We advise performing field density tests on at least every other lift to monitor compaction. As an alternate, we suggest using 1-inch clean crushed limestone to provide improved drainage and to reduce lateral pressures on the walls. Due to a slight risk of migration of soil fines into the clean rock, a synthetic filter fabric, such as Mirafi 140N or equivalent, should be placed between the soil face of the excavation and the crushed limestone. If clean rock is used, it may be placed in 2-foot-thick lifts and tamped or tracked to achieve adequate densification. Exterior clean rock backfill should be capped with cohesive soil to reduce the potential for surface water infiltration.

Backfill placed next to walls should be compacted with hand operated equipment and not large self-propelled or machine operated equipment, which could result in potential overcompaction and higher lateral pressures. Compaction should be reduced within approximately 1 foot of the walls, and the walls should be observed periodically for signs of movement. If movement is detected, it may be necessary to provide bracing and/or change backfill procedures.

In addition to the minimum density requirements listed above, the soil must be stable, i.e., not "pumping" or rutting excessively under construction traffic, prior to placing additional fill or constructing foundations, floor slabs, or pavements. Field density tests should be performed on each lift of fill to document that proper compaction is achieved.

5.3 Shallow Foundation Excavations

SCI should observe all footing and floor slab excavations for problem areas, such as soft zones or areas of untreated high plastic clay or existing fill, prior to placing concrete. Excessive disturbance of siltier soils in footing excavations should be avoided and could complicate construction. The potential for such disturbance will increase during wetter times of the year. Footing excavations that have been excessively disturbed should be overdeepened to approved undisturbed soils. Overexcavation and replacement with structural fill should be performed where inadequate bearing materials are present in footing excavations.

The base of all excavations should be clean, free of loose soil or uncompacted fill, relatively dry and maintained near their optimum moisture content. Excavations should be protected from extreme temperatures, precipitation, and construction disturbances. To reduce the possibility of desiccation or saturation of the foundation soils, we recommend that the concrete be placed as soon as possible after excavations are made.

Groundwater is not anticipated to be encountered in the footing excavations. However, in most situations, small amounts of groundwater seepage into the excavations can be handled by means of gravity ditching and a sump pump. If greater flows are experienced, SCI should be retained to provide additional consultation.

5.4 Subgrade Considerations

Floor slab and pavement subgrades may be subjected to construction traffic and exposure to weather for an extended period and significant problems may be incurred. It may be necessary to proofroll the subgrade, in both cut and fill areas, and recompact the subgrade immediately prior to placing base rock for the floor slab or pavement. In addition, subgrades covered with base rock may be very slow to dry if precipitation occurs after placing the base rock. Therefore, we recommend that proofrolling and placement of the base rock be done as close to the time of pouring the floor slab or paving as is practical. Proofroll passes should be limited, particularly on silty subgrades, to reduce the potential for pumping of moisture from deeper within the soil profile.

Special measures may be required to facilitate construction during wet or cold weather, or where excessive areas of soft soils are identified. These measures may include, but are not limited to, the addition of lime to the subgrade soils for drying purposes, or the removal of soft spongy soils and their replacement with crushed limestone. Soft areas should be selectively undercut and backfilled with properly compacted cohesive soil. A geotextile, such as Mirafi 600X, or geogrid, such as Tensar TriAx-140, or equivalents, may be used to help stabilize particularly soft areas. Where possible, the subgrade should be sloped to provide drainage.

5.5 Excavation Bracing Requirements

In the *Federal Register*, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P." This document was issued to provide for the safety of workers entering excavations, including utility trenches, basements, footings, and others. All operations should be performed under the supervision of qualified site personnel in accordance with OSHA regulations.

5.6 Erosion Control and Land Disturbance Monitoring Program

Appropriate erosion and sediment control measures, such as proper contouring during site grading activities, the installation of siltation fences, and/or inlet protection, should be used during construction to keep eroded materials from being carried onto adjacent properties or waterbodies. Depending on the length of time the subgrade is exposed and the amount of siltation that occurs, it may be necessary to periodically remove materials collected by the sediment control systems. Timely sodding and/or seeding of sloped surfaces will help reduce this potential problem.

SCI recommends following the procedures detailed in the Stormwater Pollution Prevention Plan (SWPPP). Any site disturbing more than one acre of ground must obtain a Land Disturbance Permit from the Missouri Department of Natural Resources (MDNR). As part of the permit compliance procedures, weekly and rain-event site observations must be performed to document the changing site conditions and maintenance of control measures.

6.0 CONSTRUCTION MONITORING PROGRAM

The following list summarizes SCI's recommendations for a construction monitoring program. These services are recommended to provide quality assurance in assessing design assumptions and to document earth-related construction procedures for compliance with plans, specifications, and good engineering practice. SCI should be retained to:

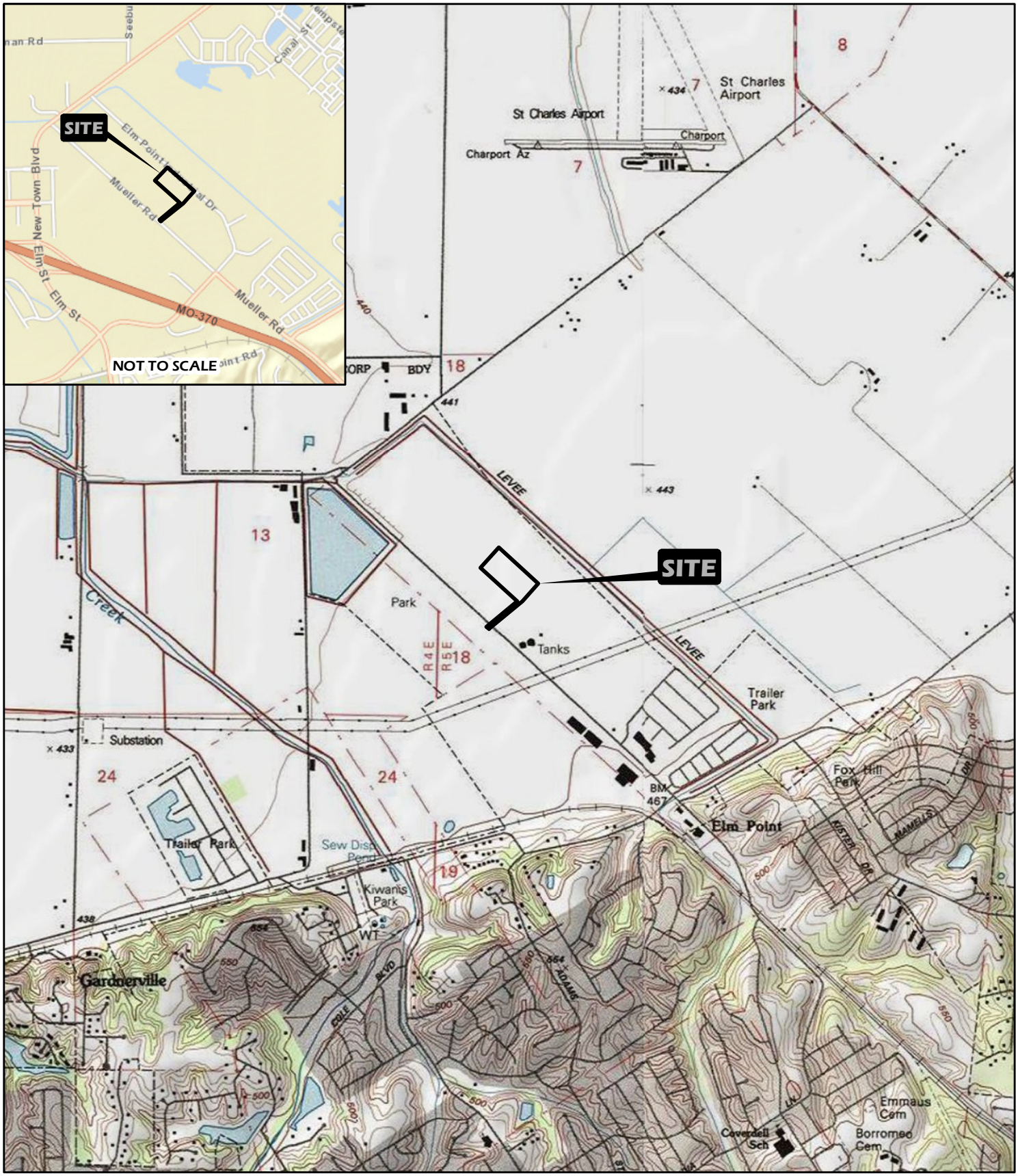
- Participate in a formal preconstruction meeting with the Owner's Representative, Civil Engineer, and Contractor, prior to construction at the site.
- Observe site preparation activities prior to construction, including stripping and proofrolling.
- Conduct and document weekly and rain-event observations at the site, maintain and update on-site paperwork, and provide submittals required by the SWPPP and Land Disturbance Permit.
- Assess the suitability of potential fill materials, including both on-site and off-site sources.
- Monitor placement and compaction of structural fill and backfill.
- Observe foundation excavations and the floor slab subgrade to assess the impact of fat clay, and to recommend the extent of remedial measures.
- Observe footing excavations for adequacy of bearing materials.
- Observe the floor slab subgrade prior to placing base rock.
- Observe backfilling of below-grade utility excavations.
- Observe pavement subgrade preparation and provide observation and testing services for the base course and pavement section.
- Check the thickness of pavement sections and, for asphaltic concrete, its density.
- Provide quality assurance testing of structural concrete and pavement materials.

7.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of our client. It is imperative that SCI be contacted by any third-party interests to evaluate the applicability of this report relative to use by anyone other than our client. Our recommendations are specific only to the project described, and are not meant to supercede more stringent requirements of local ordinances. They are based on subsurface information obtained at sixteen specific widely-spaced, boring locations within the project area; our understanding of the project as presented in Section 2.0, "Site and Project Description"; and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. SCI should be contacted if conditions encountered are not consistent with those described.

We should also be provided with a set of final development plans, once they are available, to review whether our recommendations have been understood and applied correctly, and to assess the need for additional exploration or analysis. Failure to provide these documents to SCI may nullify some or all of the recommendations provided herein. In addition, any changes in the planned project or changed site conditions may require revised or additional recommendations on our part.

The final part of our geotechnical service should consist of direct observation during construction, to observe that conditions actually encountered are consistent with those described in this report, and to assess the appropriateness of the analyses and recommendations contained herein. SCI cannot assume responsibility or liability for the adequacy of its recommendations without being retained to observe construction.

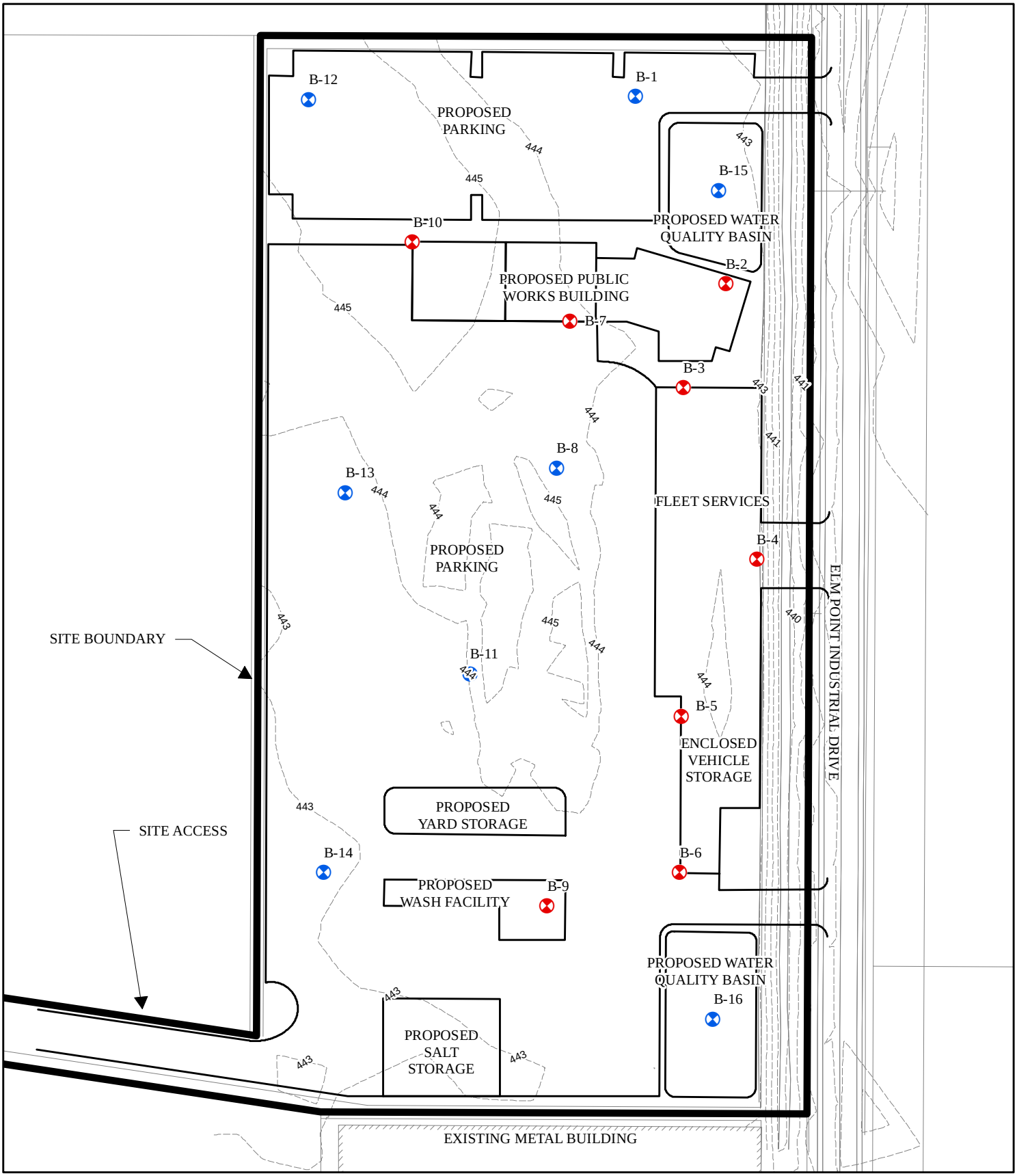


PROJECT NAME CITY OF SAINT CHARLES - NEW PUBLIC WORKS FACILITY SAINT CHARLES, MISSOURI				**GENERAL NOTES/LEGEND** USGS TOPOGRAPHIC MAP KAMPVILLE, MISSOURI QUADRANGLE DATED 1994 10' CONTOURS
VICINITY AND TOPOGRAPHIC MAP				
DRAWN BY	RCV	**DATE**	**JOB NUMBER**	
CHECKED BY	SLE	06/2013	2013-0394.10	

N W E S

SCALE 1" = 2000'

FIGURE 1



PROJECT NAME	CITY OF SAINT CHARLES - NEW PUBLIC WORKS FACILITY SAINT CHARLES, MISSOURI		
	SITE PLAN		
DRAWN BY	RCV	**DATE**	**JOB NUMBER**
CHECKED BY	SLE	06/2013	2013-0394.10

GENERAL NOTES/LEGEND

INDICATES APPROXIMATE STRUCTURAL SOIL BORING LOCATIONS.

INDICATES APPROXIMATE CIVIL SOIL BORING LOCATIONS.

BASED ON A PLAN DATED 02/05/2013 BY H DESIGN ARCHITECTURE. DIMENSIONS AND LOCATIONS ARE APPROXIMATE; ACTUAL MAY VARY. DRAWING SHALL NOT BE USED OUTSIDE THE CONTEXT OF THE REPORT FOR WHICH IT WAS GENERATED.

SCALE 1" = 100'

FIGURE 2

Appendix A

SCI ENGINEERING, INC.
130 Point West Boulevard
St. Charles, Missouri 63301
636-949-8200 Fax 636-949-8269
www.sciengineering.com

BORING LOG LEGEND AND NOMENCLATURE

Depth is in feet below ground surface. **Elevation** is in feet mean sea level, site datum, or as otherwise noted.

Sample Type

- **SS** Split-spoon sample, disturbed, obtained by driving a 2-inch-O.D. split-spoon sampler (ASTM D 1586).
- **NX** Diamond core bit, nominal 2-inch-diameter rock sample (ASTM D 2113).
- **ST** Thin-walled (Shelby) tube sample, relatively undisturbed, obtained by pushing a 3-inch-diameter, tube (ASTM D 1587).
- **CS** Continuous sample tube system, relatively undisturbed, obtained by split-barrel sampler in conjunction with auger advancement.
- **SV** Shear vane, field test to determine strength of cohesive soil by pushing or driving a 2-inch-diameter vane, and then shearing by torquing soil in existing and remolded states (ASTM D 2573).
- **BS** Bag sample, disturbed, obtained from cuttings.

Recovery is expressed as a ratio of the length recovered to the total length pushed, driven, cored.

Blows Numbers indicate blows per 6 inches of split-spoon sampler penetration when driven with a 140-pound hammer falling freely 30 inches. The number of total blows obtained for the second and third 6-inch increments is the N value (Standard Penetration Test or SPT) in blows per foot (ASTM D 1586). Practical refusal is considered to be 50 or more blows without achieving 6 inches of penetration, and is expressed as a ratio of 50 to actual penetration, e.g., 50/2 (50 blows for 2 inches).

For analysis, the N value is used when obtained by a cathead and rope system. When obtained by an automatic hammer, the N value may be increased by a factor of 1.3.

Vane Shear Strength is expressed as the peak strength (existing state) / the residual strength (remolded state).

Description indicates soil constituents and other classification characteristics (ASTM D 2488) and the Unified Soil Classification (ASTM D 2487). Secondary soil constituents (expressed as a percentage) are described as follows:

Trace	<5
Few	5-15
With	>15-30

Stratigraphic Breaks may be observed or interpreted, and are indicated by a dashed line. Transition between described materials may be gradual.

Laboratory Test Results

- Natural moisture content (ASTM D 2216) in percent.
- Dry density in pounds per cubic foot (pcf).
- Hand penetrometer value of apparently intact cohesive sample in kips per square foot (ksf).
- Unconfined compressive strength (ASTM D 2166) in kips per square foot (ksf).
- Liquid and Plastic Limits (ASTM D 4318) in percent.

RQD (Rock Quality Designation) is the ratio between the total length of core segments 4 inches or more in length and the total length of core drilled. RQD (expressed as a percentage) indicates insitu rock quality as follows:

Excellent	90 to 100
Good	75 to 90
Fair	50 to 75
Poor	25 to 50
Very Poor	0 to 25

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-1
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 443.5± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL									
					FAT CLAY (CH): Dark gray, trace brown, trace organics									443.5
	1	SS		1 2 3				42		2.0				
3					Becomes gray, trace brown									441
	2	SS		2 4 4				36		3.5				
					Trace fine gravel, no organics									438
6	3	SS		2 3 3				40		3.0				
					Becomes gray, with brown									435
9	4	SS		2 3 3				40		4.0				
					Boring terminated at 10 feet.									432
12														
														429
15														
														426
18														

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.5	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-2
LOCATION Saint Charles, Missouri
SHEET 1 **of** 2
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 443± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LAB: MOISTURE CONTENT (%)	LAB: DRY DENSITY (pcf)	LAB: HAND PENETROMETER (ksf)	LAB: UNCONFINED COMPRESSIVE STRENGTH (ksf)	LAB: LIQUID LIMIT	LAB: PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL LEAN CLAY (CL): Brown, with gray, trace organics									
	1	SS		2 2 2				24		3.0				441
					FAT CLAY (CH): Dark gray									
3														
	2	SS		2 3 4				37		3.5		96	72	438
					Becomes gray, trace brown, trace fine gravel									
6	3	SS		3 3 3				35		3.0				
					Becomes gray, with brown									435
9	4	SS		2 3 3				38		3.5				
														432
12														
	5	SS		2 3 3				42		3.5				429
15														
														426
18														
	6	SS		2 3 3				36		3.0				

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility | **BORING NUMBER** B-2
LOCATION Saint Charles, Missouri | **SHEET** 2 **of** 2
DRILLER Midwest Drilling, Inc. | **HAMMER** Automatic | **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA | **ELEVATION** 443± | **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
21					FAT CLAY (CH): Gray, with brown *(Continued)*									
														420
					Becomes gray, trace brown									
24	7	SS		2 3 4				33		3.0				
														417
27					LEAN CLAY (CL): Gray, trace brown, with sandy silt layers, trace fine gravel									
	8	SS		2 2 2				38		1.5				414
30					Boring terminated at 30 feet.									
														411
33														
														408
36														
														405
39														

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-3
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 443.5± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LAB: MOISTURE CONTENT (%)	LAB: DRY DENSITY (pcf)	LAB: HAND PENETROMETER (ksf)	LAB: UNCONFINED COMPRESSIVE STRENGTH (ksf)	LAB: LIQUID LIMIT	LAB: PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL FAT CLAY (CH): Dark gray, trace organics									
	1	SS		3 3 3				41		3.0				
3					Trace fine gravel, no organics									441
	2	SS		3 3 4				35		3.5				
6														438
	3	SS		3 3 3				38		3.0				
					Becomes gray, with brown, no gravel									435
9	4	SS		2 2 2				47		1.5				
12					Trace fine gravel									432
	5	SS		3 3 4				43		3.0				429
15					Boring terminated at 15 feet.									
18														426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility | **BORING NUMBER** B-4
LOCATION Saint Charles, Missouri | **SHEET** 1 **of** 2
DRILLER Midwest Drilling, Inc. | **HAMMER** Automatic | **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA | **ELEVATION** 443± | **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LAB: MOISTURE CONTENT (%)	LAB: DRY DENSITY (pcf)	LAB: HAND PENETROMETER (ksf)	LAB: UNCONFINED COMPRESSIVE STRENGTH (ksf)	LAB: LIQUID LIMIT	LAB: PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL									
		ST			ST									
	1	ST	12/24											441
3					FAT CLAY (CH): Gray, trace organics									
	2	SS		2 3 3				41		3.0				438
					Trace fine gravel									
6	3	SS		2 3 3				40		3.5				
					Becomes gray, with brown, no gravel									435
9	4	SS		2 2 3				45		2.5				
														432
12														
	5	SS		2 2 2				51		1.0		91	64	429
15														
														426
18														
	6	SS		3 3 3				46		2.5				

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
7.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-4
LOCATION Saint Charles, Missouri
SHEET 2 **of** 2
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 443± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
21					FAT CLAY (CH): Gray, with brown *(Continued)*									
														420
24	7	SS		3 4 4	Trace fine gravel			30		3.0				
					Boring terminated at 25 feet.									417
27														
														414
30														
														411
33														
														408
36														
														405
39														

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
7.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-5
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 444± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL FAT CLAY (CH): Dark gray, trace organics									
	1	SS		2 2 3				40		3.0				
3														441
	2	SS		2 3 3				36		3.0				
					No organics									
6														438
	3	SS		2 2 3				38		3.0				
					Becomes gray, with brown, trace fine gravel									
9														435
	4	SS		1 2 2				43		3.5				
12														432
	4	SS		2 3 3				39		3.5				
15					Boring terminated at 15 feet.									429
18														426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
7.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-6
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 444± **DATE DRILLED** 06/04/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL FAT CLAY (CH): Dark gray, trace organics									
	1	SS		2 3 3				41		3.0				
3														441
	2	SS		2 3 3				36		4.0				
6					Becomes gray, trace brown, trace fine gravel, no organics									438
	3	SS		2 3 3				31		3.5				
					Becomes gray, with brown									
9	4	SS		2 3 4				34		3.5				435
12														432
	5	SS		2 4 4				38		3.5				
15														429
18					Becomes gray, no gravel									426
	6	SS		3 3 4				37		3.5				
					Boring terminated at 20 feet.									

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
18.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-7
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 444± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL FAT CLAY (CH): Dark gray									
	1	SS		2 3 4				41		3.0				
3														441
	2	ST	12/24		ST									
6														438
	3	SS		2 3 4	Becomes gray, trace brown, trace fine gravel			40		3.0				
9	4	SS		2 3 3				43		2.5				435
12														432
					Becomes gray, with brown									
	5	SS		2 3 4				42		3.0				
15														429
18					Becomes gray									426
	6	SS		3 4 5				30		4.0				
					Boring terminated at 20 feet.									

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
9.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-8
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 444.5± **DATE DRILLED** 06/04/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL FAT CLAY (CH): Dark gray									444
	1	SS		2 2 3				43		3.0				
3					Becomes gray, trace fine gravel									441
	2	SS		2 4 4				40		3.0				
6														
	3	SS		2 3 3				39		3.0				438
					Becomes gray, with brown									
9	4	SS		1 2 3				47		2.0				435
					Boring terminated at 10 feet.									
12														432
15														429
18														426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
5.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-9
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 443.5± **DATE DRILLED** 06/04/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL									
					FAT CLAY (CH): Dark gray, trace organics									
	1	SS		1 2 2				45		2.0				441
3					Trace fine gravel									
	2	SS		2 4 4				42		2.5		107	83	438
6					Becomes gray, trace brown									
	3	SS		2 3 3				43		2.5				435
					Becomes gray, with brown									
9	4	SS		2 2 3				46		2.0				432
12														429
	5	SS		3 4 4				41		3.0				
15					Boring terminated at 15 feet.									426
18														

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility | **BORING NUMBER** B-10
LOCATION Saint Charles, Missouri | **SHEET** 1 **of** 2
DRILLER Midwest Drilling, Inc. | **HAMMER** Automatic | **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA | **ELEVATION** 445± | **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LAB: MOISTURE CONTENT (%)	LAB: DRY DENSITY (pcf)	LAB: HAND PENETROMETER (ksf)	LAB: UNCONFINED COMPRESSIVE STRENGTH (ksf)	LAB: LIQUID LIMIT	LAB: PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL									
					FILL: Brown and gray, lean and fat clay									444
	1	SS		3 5 6				24		6.0				
3					FAT CLAY (CH): Dark gray									
	2	SS		3 4 5				42		4.0				441
6														
	3	SS		3 3 4				39		3.5				438
					Becomes gray, with brown									
9	4	SS		1 2 3				44		3.0				435
12					Trace fine gravel									432
	5	SS		2 2 3				43		3.0				
15														429
18														
	6	SS		2 3 4				48		2.5				426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.5	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-10
LOCATION Saint Charles, Missouri
SHEET 2 **of** 2
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 445± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
21					FAT CLAY (CH): Gray, with brown, trace fine gravel *(Continued)*									423
24	7	SS		3 4 4				29		4.5				420
27					LEAN CLAY (CL): Gray, trace brown, trace fine sand and gravel									417
30	8	SS		3 3 3				32		<0.25				414
					Boring terminated at 30 feet.									
33														411
36														408
39														

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.5	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-11
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 444± **DATE DRILLED** 06/04/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
0					FILL: Brown, lean clay		1							444
	1	SS		2 3 3				40		4.0				
					FAT CLAY (CH): Dark gray, trace fine gravel and organics									
3														441
	2	SS		2 3 4	Becomes dark gray, trace brown, no organics			39		4.5				
6														438
	3	SS		3 3 3				39		4.0				
					Becomes gray, with brown									
9	4	SS		2 3 3				45		3.0				435
					Boring terminated at 10 feet.									
12														432
15														429
18														426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.0 ft	WHILE DRILLING
ft	___ HRS AFTER DRILLING
ft	___ DAYS AFTER DRILLING

REMARKS:
1) Driller's observation

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-12
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 445± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LAB: MOISTURE CONTENT (%)	LAB: DRY DENSITY (pcf)	LAB: HAND PENETROMETER (ksf)	LAB: UNCONFINED COMPRESSIVE STRENGTH (ksf)	LAB: LIQUID LIMIT	LAB: PLASTICITY INDEX	ELEVATION (ft)
					FILL: Brown silt and dark gray fat clay									
	1	SS		3 4 5				21		6.0				444
3					FAT CLAY (CH): Dark gray									
	2	SS		2 3 4				42		2.5				441
6														
	3	SS		2 3 4				41		2.5				438
					Becomes gray, with brown, trace fine gravel										
9	4	SS		2 2 3				44		2.0				435
					Boring terminated at 10 feet.									
12														432
15														429
18														426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.5	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-13
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 444± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL									
					FAT CLAY (CH): Dark gray, trace brown, trace organics									
	1	SS		2 3 3				41		4.0				
3														441
	2	SS		2 3 3	Becomes gray, trace fine gravel			43		2.5				
6														438
	3	SS		2 2 3	Becomes gray, trace brown			44		3.0				
					Becomes gray, with brown									
9	4	SS		2 3 3				40		2.5				435
					Boring terminated at 10 feet.									
12														432
15														429
18														426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
7.5	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility
BORING NUMBER B-14
LOCATION Saint Charles, Missouri
SHEET 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 443± **DATE DRILLED** 06/04/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					1" TOPSOIL FAT CLAY (CH): Dark gray, trace organics									
	1	SS		1 2 2				44		2.0				441
3														
	2	SS		2 3 4	Becomes gray, trace fine gravel			44		2.0				438
6														
	3	SS		2 2 2	Becomes gray, trace brown			42		3.0				
					Becomes gray, with brown									435
9	4	SS		2 2 2				44		3.0				
					Boring terminated at 10 feet.									432
12														
														429
15														
														426
18														

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility | **BORING NUMBER** B-15
LOCATION Saint Charles, Missouri | **SHEET** 1 **of** 1
DRILLER Midwest Drilling, Inc. | **HAMMER** Automatic | **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA | **ELEVATION** 443± | **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
					2" TOPSOIL									
	1	SS		2 2 3 3	FAT CLAY (CH): Dark gray, trace organics			40		3.0				
														441
3	2	SS		2 2 3 5	Trace fine gravel			40		2.5				
	3	SS		3 3 4 5	Becomes gray			42		2.5				438
6														
	4	SS		2 3 3 4	Becomes gray, trace brown			41		3.0				
					Becomes gray, with brown									435
9	5	SS		3 3 4 4				34		3.5				
					Boring terminated at 10 feet.									
														432
12														
														429
15														
														426
18														

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
9.5	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

BORING LOG

PROJECT City of Saint Charles - New Public Works Facility **BORING NUMBER** B-16
LOCATION Saint Charles, Missouri **SHEET** 1 **of** 1
DRILLER Midwest Drilling, Inc. **HAMMER** Automatic **PROJECT NO.** 2013-0394.10
EQUIPMENT CME-550 w/CFA **ELEVATION** 443± **DATE DRILLED** 06/05/13

DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in/in)	SAMPLE BLOWS (per 6 in)	DESCRIPTION (UNIFIED SOIL CLASSIFICATION)	GRAPHIC	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	HAND PENETROMETER (ksf)	UNCONFINED COMPRESSIVE STRENGTH (ksf)	LIQUID LIMIT	PLASTICITY INDEX	ELEVATION (ft)
	1	SS		1 3 3 3	1" TOPSOIL LEAN CLAY (CL): Brown, trace gray, trace organics FAT CLAY (CH): Dark gray			42		3.0				441
3	2	SS		2 2 4 5	Trace fine gravel			41		2.5				
	3	SS		3 3 4 4	Becomes gray, trace fine roots			41		2.5				438
6	4	SS		2 3 4 4	Becomes gray, trace brown			43		2.5				
	5	SS		2 2 4 4	Becomes gray, with brown			41		2.5				435
9					Boring terminated at 10 feet.									
12														432
15														429
18														426

WATER LEVEL:

	NONE OBSERVED WHILE DRILLING
8.0	ft WHILE DRILLING
	ft ___ HRS AFTER DRILLING
	ft ___ DAYS AFTER DRILLING

REMARKS:

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL REPORT

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following suggestions and observations are offered to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical study is unique, each geotechnical report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Report Is Based on a Unique Set of Project-specific Factors

Geotechnical engineers consider a number of unique project-specific factors when establishing the scope of a study. Typical factors include the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and its configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect the:

- function and character of the proposed structure,
- elevation, configuration, location, orientation, or loading of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical report whose adequacy may have been affected by the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective way of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Report is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

The preceding paragraphs are based on information provided by ASFE.

ASFE

8811 Colesville Road, Suite G106
Silver Spring, Maryland 20910
Telephone 301-565-2733 Facsimile 301-589-2017
Email info@asfe.org www.asfe.org

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BID FORM – Stipulated Sum (Single-Prime Contract) Due February 16, 2021 at 2:00 pm

The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

Below is a contact for the BIDDER submitting this bid, who will be responsible for any questions that may arise during bid review and who may also be contacted to discuss the acceptance or rejection of this bid:

BIDDER Company Name	
BIDDER Contact Person Name	
Address	
City/State/Zip	
Phone Number	
Email Address	
Fax Number	

BIDDER accepts all of the terms and conditions of the "Notice to Bidders" and the "Instructions to Bidders", including without limitation those dealing with the disposition of Bid security.

Bidding and Contract Requirements

STIPULATED SUM BID FORM

Name of Project: **St. Charles Public Works Facility Addition**

Date:_____

Proposal from:_____

(Hereinafter called Bidder), a corporation organized and existing under the laws of the state of_____, a partnership, or an individual doing business as_____ (cross out inapplicable).

TO: ATTN: Willie Hantack, Purchasing Manager
The City of St. Charles
200 N. Second Street
St. Charles, MO 63301

Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by H Design Group (Hereinafter called Architect) and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

BASE BID

St. Charles Public Works Facility Addition					
ITEM NO.	ITEM DESCRIPTION	UNIT	PRICE PER UNIT	QUANTITY	SUB-TOTAL
1	Scope Coordination & Unforeseen Conditions Allowance (Allowance for use by Owner only, not for use by the Contractor. Any unused portion shall be credited to the Owner at Substantial Completion)	Lump Sum	$50,000	1	$50,000
2	Builder's Risk Insurance	Lump Sum		1	
3	Payment & Performance Bond	Lump Sum		1	
4	Remaining Scope of Work	Lump Sum		1	

Furnish all labor, tools, equipment, and material required to perform all work indicated above for this bid package, as defined in the Bid Documents (including costs for Payment and Performance Bonds) for the **TOTAL LUMP SUM AMOUNT of (as the total of Items 1, 2, 3, and 4 in above table):**

_____ **Dollars**

$ _____

TIME – To be submitted at the time of bid.

Board approval and issuance of conditional Notice to Proceed is anticipated to occur on March 8, 2021. BIDDER hereby states that the time required to perform all work indicated in the BID DOCUMENTS (and any accepted alternates) and work necessary to complete the project per the project per the duration proposed on this Bid Form is acceptable. Damages shall be assessed for delays to Substantial Completion and are further described in the bidding and contract requirements.

Bidders shall propose a contractual duration for achieving Substantial Completion in the blank space below. Proposed duration will be utilized as criteria for selection of General Contractor.

Complete all work related to new construction, site development, and bid alternates to achieve Substantial Completion within _____ calendar days from the issuance of the Notice to Proceed.

Substantial completion shall be no later than September 1, 2021.

ALTERNATES - To be submitted at the time of bid.

Bids will not be accepted if these alternates are not provided at the time of bid. Refer to section 01 2300 – ALTERNATES for full description of ALTERNATES.

Alternate No. One - DEDUCT AISC Certified Fabricator Requirement

$ _____

Bid Bond Form (AIA Document A310-2010) – To be submitted at the time of bid.

BID GUARANTEE
The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within 10 days after a written Notice of Award, if offered within 60 days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the amount constituting five percent (5%) of the Base Bid amount above.

In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

AFFIDAVIT OF WORK AUTHORIZATION

The grantee, sub grantee, contractor or subcontractor who meets the section 285.525, RSMo definition of a business entity must complete and return the following Affidavit of Work Authorization.

Comes now_____ (Name of Business Entity Authorized Representative) as_____ (Position/Title)

first being duly sworn on my oath, affirm_____(Business Entity Name) is enrolled and will continue to participate in the E-Verify Federal Work Authorization program with respect to employees hired after enrollment in the program who are proposed to work in connection with the services related to _____ (Bid/Grant/Sub grant/Contract/Subcontract) for the duration of the grant, sub grant, contractor, or subcontractor, if awarded in accordance with subsection 2 of section 285.530, RSMo. I also affirm that _____ (Business Entity Name)

does not and will not knowingly employ a person who is an unauthorized alien in connection with the contracted services related to _____ (Bid/Grant/Sub grant/Contract/Subcontract) for the duration of the grant, sub grant, contract, or subcontract, if awarded.

In Affirmation thereof, the facts stated above are true and correct. (The undersigned understands that false statements made in this filing are subject to the penalties provided under section 575.040, RSMo.)

Authorized Representative's Signature Printed Name

Title Date

Subscribed and sworn to before me this Day of _____. I am Month, Year

Commissioned as a notary public within the County of _____, State of _____ and my commission expires on Date

Signature of Notary Date

AFFIDAVIT OF WORK AUTHORIZATION

(Continued)

CURRENT BUSINESS ENTITY STATUS

I certify that _____ (Business Entity Name) **MEETS** the definition of a business entity as defined in section 285.525, RSMo pertaining to section 285.530, RSMo as stated above.

Authorized Business Entity Representative's Name (Please Print)	Authorized Business Entity Representative's Signature
Business Entity Name	Date

As a business entity, the grantee, sub grantee, contractor, or subcontractor must perform/provide the following. The grantee, sub grantee, contractor, or subcontractor shall check each to verify completion/submission:

- Enroll and participate in the E-Verify Federal Work Authorization Program (Website: http://www.dhs.gov/e-verify; Phone: 888-464-4218 Email: e-verify@dhs.gov) with respect to the employees hired after enrollment in the program who are proposed to work in connection with the services required herein;

  AND

- Provide documentation affirming said company's/individual's enrollment and participation in the E-Verify Federal Work Authorization Program. Documentation shall include a page from the E-Verify Memorandum of Understanding (MOU) listing the grantee's, sub grantee's, contractor's. or subcontractor's name and the MOU signature page completed and signed, at minimum, by the grantee, sub grantee, contractor, or subcontractor and the Department of Homeland Security – Verification Division; (if the signature page of the MOU lists the grantee's, sub grantee's, contractor's, or subcontractor's name, then no additional pages of the MOU must be submitted).

Form **W-9**
(Rev. December 2014)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Give Form to the requester. Do not send to the IRS.

Print or type
See Specific Instructions on page 2.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.

2 Business name/disregarded entity name, if different from above

3 Check appropriate box for federal tax classification; check only **one** of the following seven boxes:

☐ Individual/sole proprietor or single-member LLC ☐ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate

☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=partnership) ▶ _____

Note. For a single-member LLC that is disregarded, do not check LLC; check the appropriate box in the line above for the tax classification of the single-member owner.

☐ Other (see instructions) ▶

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):
Exempt payee code (if any) _____
Exemption from FATCA reporting code (if any) _____
(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.)

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Note. If the account is in more than one name, see the instructions for line 1 and the chart on page 4 for guidelines on whose number to enter.

Social security number
☐☐☐ - ☐☐ - ☐☐☐☐

or

Employer identification number
☐☐ - ☐☐☐☐☐☐☐

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions on page 3.

Sign Here | **Signature of U.S. person** ▶ | **Date** ▶

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. Information about developments affecting Form W-9 (such as legislation enacted after we release it) is at *www.irs.gov/fw9*.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following:

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See *What is backup withholding?* on page 2.

By signing the filled-out form, you:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income, and
4. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting, is correct. See *What is FATCA reporting?* on page 2 for further information.

Cat. No. 10231X

Form **W-9** (Rev. 12-2014)

CERTIFICATION REGARDING ISRAEL

1. Contractor hereby certifies in writing to The City of St. Charles, MO as follows (for purposes of this certification, Contractor shall be referred to as Company):

That Company is not currently engaged in and shall not, for the duration of the contract, engage in a boycott of goods or services from the State of Israel; companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel; or persons or entities doing business in the State of Israel.

2. As used in this certification, the following terms and phrases shall be defined as follows:

(a) "Boycott Israel" and "boycott of the State of Israel", engaging in refusals to deal, terminating business activities, or other actions to discriminate against, inflict economic harm, or otherwise limit commercial relations specifically with the State of Israel; companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel; or persons or entities doing business in the State of Israel, that are all intended to support a boycott of the State of Israel. A company's statement that it is participating in boycotts of the State of Israel; companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel; or persons or entities doing business in the State of Israel, or that it has taken the boycott action at the request, in compliance with, or in furtherance of calls for a boycott of the State of Israel; companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel; or persons or entities doing business in the State of Israel shall be considered to be conclusive evidence that a company is participating in a boycott of the State of Israel; companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel; or persons or entities doing business in the State of Israel; provided, however that a company that has made no such statement may still be considered to be participating in a boycott of the State of Israel; companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel; or persons or entities doing business in the State of Israel if other factors warrant such a conclusion; and

(b) "Company", any for-profit or not-for-profit organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, limited liability company, or other entity or business association, including all wholly-owned subsidiaries, majority-owned subsidiaries, parent companies, or affiliates of those entities or business associations.

CERTIFICATION REGARDING ISRAEL

(CONTINUED)

In Witness Whereof, the foregoing certification is entered into as of _____, 20____.

Contractor/Company:_____

By:_____

Authorized Party

UNIT PRICES - To be submitted to Owner 24 Hours after Bid Date/Time.
Unit Prices shall for scope adjustments after award shall be provided for the items listed in section 012200 – UNIT PRICES. **Bidder shall use the Supplemental Bid Information form provided and submit within 24 hours of the Bid date and time.**

COST BREAKOUT – To be submitted to Owner 24 Hours after Bid Date/Time.
See form provided in Specification labeled as "Supplemental Bid Information" to submit to Owner 24 hours after bid date/time.

LIST OF PROPOSED SUBCONTRACTORS – To be submitted to Owner 24 Hours after Bid Date/Time.
See form provided in Specification labeled as "Supplemental Bid Information" to submit to Owner 24 hours after bid date/time. List all potential contract amounts as well for proposed subcontractors.

QUALIFICATIONS – To be submitted to Owner 24 Hours after Bid Date/Time.
See form provided in Specification labeled as "Supplemental Bid Information" to submit to Owner 24 hours after bid date/time.

REFERENCES – To be submitted to Owner 24 Hours after Bid Date/Time.
See form provided in Specification labeled as "Supplemental Bid Information" to submit to Owner 24 hours after bid date/time.

BID DOCUMENTS

A. Bidder acknowledges receipt of the following Appendixes & Addenda:

1. Drawings and Specifications
2. Addenda
   - a. Addenda No. _____ Dated _____
   - b. Addenda No. _____ Dated _____
   - c. Addenda No. _____ Dated _____
   - d. Addenda No. _____ Dated _____
   - e. Addenda No. _____ Dated _____

MISCELLANEOUS BID REQUIREMENTS

A. The undersigned understands that this bid shall be good and may not be withdrawn for a period of sixty (60) calendar days after the scheduled closing time and date for receiving bids.

B. The undersigned understands that the Owner reserves the right to reject any or all bids or subcontractors.

C. The undersigned further agrees to indemnify and save the Owner from and against all losses, judgments of every nature and description made, brought, or recovered against the Owner by reason of any act or omission of the undersigned, his agents, subcontractors, or employees in the execution of the work or in guarding the same.

D. The undersigned hereby declares that this Stipulated Sum Bid is based solely upon the materials and equipment described in the bidding documents (including Addenda), and that no substitutions are contemplated.

E. The Bidder declares that he/she has had an opportunity to examine the site of the work and he/she has examined the bidding Documents therefore, and that he/she has carefully prepared his Bid upon the basis thereof and that he/she has carefully examined and checked this Bid and the materials, equipment and labor required thereunder, the cost thereof, and his figures therefor, and hereby states that the amount or amounts set forth in this Bid is, or are, correct and that no mistake or error has occurred in this bid.

F. See next page for signatures. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in Missouri, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

IF A CORPORATION

Name of Corporation _____ Signature of Officer _____

Name and Title of Officer _____

Incorporated under the laws of the State of _____ (Print)

Licensed to do business in Missouri? (Check one) [ ] Yes [ ] No

Address for Communications _____

_____

(Seal if bid is by a corporation.)

IF A PARTNERSHIP State name and address of all partners:

Name of Partnership _____ _____

_____

Signature of Authorized Partner _____ _____

_____

IF INDIVIDUAL

Name of Firm (if any) _____ _____

Address for Communications

Signature of Individual _____ _____

Name of Individual (Print) _____ _____

IF BIDDING AS A JOINT VENTURE *(List all parties.)*

_____ _____

_____ _____

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SUPPLEMENTAL BID INFORMATION **Due February 17, 2021 at 2:00 pm**

TO: ATTN: Willie Hantack, Purchasing Manager
The City of St. Charles
200 N. Second Street
St. Charles, MO 63301

Proposal for:
St. Charles Public Works Facility Addition
2871 Elm Point Industrial Drive
St. Charles, MO 63301

This form shall be completed and submitted in its entirety no later than 24 hours following the receipt of the bids to the Owner. Bidder must submit supplemental bid information via email as follows:

Re: Supplemental Bid Information for St. Charles Public Works Facility Addition
Attn: Willie Hantack, The City of St. Charles, purchasing@stcharlescitymo.gov
CC: Joe Sweitzer, Navigate Building Solutions, joe@navigatebuildingsolutions.com

Bid Package: General Construction

Date:

Proposal From:

Bidder shall provide the breakout for the following divisions of work following breakout of costs that are **INCLUDED** in the Base Bid.

Division 1-14 and 31, 32, 33 Scopes of Work

_____ DOLLARS ($_____).

Division 21 Scope of Work (Fire Suppression)

_____ DOLLARS ($_____).

Division 22 Scope of Work (Plumbing)

_____ DOLLARS ($_____).

Division 23, 25 Scope of Work (HVAC, Temperature Controls, Testing & Balancing)

_____ DOLLARS ($_____).

Division 26 Scope of Work (Electrical)

_____ DOLLARS ($_____).

Division 27, 28 Scope of Work (Communications, Electronic Safety & Security, Audio/Visual)

_____ DOLLARS ($_____).

UNIT PRICES for Bid Package General Construction

The unit rates below are to include all general conditions, overhead, and profit. Rates are to be applied either as add or deduct rates; the same rate will apply for either condition. There will be only one rate allowed per unit price regardless of when in the construction process the rate is being applied or what trade is performing it.

Unit Price Description	Unit	$/Unit
Unit Price No. 1: Excavation, removal, and haul off of unsuitable soils and import and compaction of suitable soils per Geotechnical Report.	Per CY	
Unit Price No. 2: Lime treatment of on-site unsatisfactory soils with Code-L material tilled in to a depth and percentage per Geotechnical Report.	Per CY	
Unit Price No. 3: Removal and haul-off of rippable rock.	Per CY	
Unit Price No. 4: Removal and haul-off of non-rippable rock.	Per CY	
Unit Price No. 5: Removal and haul-off of trench rock.	Per CY	
Unit Price No. 6: Removal and disposal of existing buried concrete man-made structures.	Per CY	
Unit Price No. 7: Removal, haul-off, and disposal of unsuitable soils and placement of lean concrete for soil remediation.	Per CY	
Unit Price No. 8: Load and haul-off of surplus soils.	Per CY	

Unit Price No. 9: Soil import, placement and compaction.	Per CY	
Unit Price No. 10: 1” clean rock placement and compaction	Per CY	
Unit Price No. 11: 1” minus rock placement and compaction	Per CY	
Unit Price No. 12: 2” clean rock placement and compaction	Per CY	
Unit Price No. 13: 2” minus rock placement and compaction	Per CY	
Unit Price No. 14: Topsoil place and final grade	Per CY	
Unit Price No. 15: Excavation, removal, and haul off of unsuitable soils and import and compaction of 1” minus crushed limestone per Geotechnical Report.	Per CY	
Unit Price No. 16: Excavation, removal, and haul off of unsuitable soils and backfill with lean concrete per Geotechnical Report.		
Unit Price No. 17: Furnish and installation of Sod	Per SY	

LIST OF PROPOSED SUBCONTRACTORS for Bid Package General Construction

A list of the two apparent subcontractors in each division that are being considered for award to perform work on the jobsite including their union affiliation and their M/WBE status and amount.

If you do not plan to use subcontractors, indicate below and return this form with your bid.

Please list the two subcontractors in each category that the above referenced Bidder intends to negotiate subcontracts for materials, services, supplies, specialty contractors, etc. as follows:

Scope of Work	Proposed Subcontractors (please indicate below name whether union/non-union)	MBE/WBE Contract Amount	Contract Amount
Site Demo/ Earthwork	1. 2.		
Site Utilities	1. 2.		
Site Concrete and Asphalt	1. 2.		
Concrete Footings, Foundations, and Flatwork	1. 2.		
Pre-Engineered Metal Building Manufacturer	1. 2.		
Pre-Engineered Metal Building Installer	1. 2.		
Masonry	1. 2.		
Steel Fabricator	1. 2.		
Steel Erector	1. 2.		
Roofing	1. 2.		

Insulated Metal Panels	1. 2.		
Sheet Metal	1. 2.		
Doors, Frames, Hardware	1. 2.		
Painting	1. 2.		
Plumbing	1. 2.		
Fire Protection	1. 2.		
Mechanical	1. 2.		
Electrical/Low Voltage	1. 2.		
Security	1. 2.		

QUALIFICATIONS

Organization

1. How many years has your organization been in business as a Contractor?_____

2. How many years has your organization been in business under its present business name?_____

3. Under what other or former names has your organization operated?
   _____
   _____

4. How many persons do you have working for the company?
   Operators:____ Carpenters: _____ Laborers: _____
   Superintendents: _____ Office Management: _____ Other Trades: _____

5. What is your company's EMR? _____

6. State the amount of the deductibles on all insurance that you will be providing for the Project:

   Workers Compensation Insurance: _____
   Commercial General Liability Insurance: _____
   Automobile Liability Insurance: _____

Experience

1. On a separate sheet list all projects completed by your firm in the past five (5) years, with a contract value of $1M or greater. List project name, client, architect, total contract value, date of completion and percentage of the cost of work performed with your own forces.

2. List the categories of work that your organization normally performs with its own forces:

   1. _____
   2. _____
   3. _____
   4. _____
   5. _____

Claims And Suits

If the answer to any of the questions below is “yes”, please attach written description of details.

1. Has your organization ever failed to complete any work awarded to it?

   Yes:_____ No:_____

2. Are there any judgments, claims, arbitration proceedings, or suits pending or outstanding against your organization or its officers?

   Yes:_____ No:_____

3. Has your organization filed any lawsuits or requested arbitration with regard to construction contracts within the last five (5) years?

   Yes:_____ No:_____

Other Construction Work

1. On a separate sheet, list major construction projects your organization has in backlog and in progress, giving the name of project, owner, architect, contract amount, percent complete and scheduled completion date.

2. State total worth of work in progress and under contract:
   $_____

3. State average annual amount of construction work performed during the past five years: $_____

4. State current bonding capacity: $_____

5. State name of scheduling system currently being used:

   _____

6. **On a separate sheet, list the construction experience and present commitments of the key individuals of your organization. Please identify which individuals you intend to commit to this project if awarded the Contract.**

REFERENCES

Bids will not be accepted if references are not provided at the time of bid. Bidder shall provide at least three references of similar projects.

Company: _____

Address: _____

Contact Person: _____

Telephone: _____

Email: _____

Type of service provided: _____

Dates/year(s) service was provided: _____

Company: _____

Address: _____

Contact Person: _____

Telephone: _____

Email: _____

Type of service provided: _____

Dates/year(s) service was provided: _____

Company: _____

Address: _____

Contact Person: _____

Telephone: _____

Email: _____

Type of service provided: _____

Dates/year(s) service was provided: _____

Submitted By:

Bidder: _____

Address: _____

_____

Business Telephone: _____ Fax Number:_____

Typed/Printed Name:_____

Authorized Signature:_____

Title:_____

(Seal - if bid by a corporation)

Date:_____

END: SUPPLEMENTAL BID INFORMATION

This page is intentionally blank.

This Contract Agreement by and between **[Insert Contractor Name]**, Party of the First Part, hereinafter called the "Contractor", and City of Saint Charles Party of the Second Part, hereinafter called the "Owner" is effective as of the final date of signature below.

WITNESSETH: That the Owner and the Contractor for the consideration hereinafter named agree as follows:

ARTICLE 1. Scope of Work: Contractor shall furnish and provide for all of the labor, materials, machinery, and equipment, and perform all of the work to **Construct Heated Storage Building Addition at the City's Public Works Facility** as outlined in Contractor's response to Bid 4520, a copy of which is attached as Exhibit A.

The work to be done under this Contract consists of Constructing and completing all work described in the proposal, attached as Exhibit A.

ARTICLE 2. Time of Completion: All work shall be completed within **[Insert #]** days or Notice to Proceed, in accordance with Contractor's proposal.

It is mutually understood and agreed that time is the essence of this Agreement and in the event said work is not completed on or before the date included in the project timeline for its completion, the party of the first part, the Contractor, shall pay damages to the Owner of One Hundred Dollars ($100.00) per day. Those damages shall be used to pay the expenses of the inspectors and the services of the City Representative for the extra time required for the completion of the work. Extra time shall in all cases be construed as the time required for completion after the date herein named. Extensions of time granted by the party of the second part, the Owner, for completion of the Contract on account of fire, strikes or acts of Providence shall not be construed as extra time. The amount of such expenses and services shall be determined by the City Representative, shall be reported by the City Representative in writing to the Owner, and shall be withheld from any money due the Contractor and paid to the proper parties.

ARTICLE 3. The Contract Sum: The Owner shall pay the Contractor for the performance of the Contract a sum not to exceed **[Insert Contract Value] ($[Insert #])**, subject to additions and deductions provided herein, in current funds at the prices named in the proposal attached to and a part of these documents and the contract.

ARTICLE 4. Acceptance and Final Payment: Upon receipt of written notice that the work is ready for final inspection and acceptance, the City Representative shall promptly make such inspection, and when the work is deemed acceptable under the Contract and the Contract fully performed, a final certificate with the City Representative's signature shall be issued, stating that the work provided for in this Contract has been completed and is accepted by the City's Representative under the terms and conditions thereof, and the entire balance found to be due the Contractor shall be paid to the Contractor within thirty (30) calendar days after the date of said final certificates.

Before issuance of the final certificates the Contractor shall submit evidence satisfactory to the City Representatives that all payrolls, materials, bills, and other indebtedness connected with the work have been paid.

The holding and acceptance of the final payment shall constitute a waiver of all claims by the Owner, other than those arising from unsettled liens, faulty work appearing after final payment or from requirements of the specifications and of all claims by the Contractor, except those previously made and still unsettled.

SAMPLE

If, after the work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor and the City Representative so certifies, the Owner shall upon certificate of the City Representative, and without terminating the Contract, make payment of the balance due for the portion of the work fully completed and accepted. Such payment shall be made under the terms and conditions covering final payment, except that it shall not constitute a waiver of claims.

ARTICLE 5. The Contract Documents: The information for and instruction to bidders, proposal, the bonds, and the specifications together with the agreement, form the contract and they are as fully a part of this contract as if thereto attached or repeated.

ARTICLE 6. Prevailing Wages: Not less than the prevailing hourly rate of wages, as set out in the wage order attached to and made part of the specification for work under the contract, must be paid to all workers performing work under the contract. The contractor will forfeit a penalty to the contracting public body of $100 per day (or portion of a day) for each worker that is paid less than the prevailing rate for any work done under the contract by the contractor or by any subcontractor.

ARTICLE 7. Warranty: All labor and materials will be warranted for one (1) year from substantial completion of the project.

ARTICLE 8. Laws and Ordinances: Contractor shall comply with City Code of Ordinance Section 145.040 regarding the registration of sex offenders with the Police Department.

In accordance with City Code of Ordinance Section 145.160, neither the Contractor/Supplier or an affiliated business entity of the Contractor/Supplier shall: (1) be in arrears to the City on any taxes or debt; (2) be in default of any contractual obligation to the City; (3) be in default as security or otherwise of any obligation to the City; or (4) be a party to a non-adjudicated, non-traffic related citation for a code violation. For complete text of Section 145.160, please contact the Purchasing Office.

The contractor and all subcontractors to the contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292.675 RSMo, if they have not previously completed the program and have documentation of having done so. The contractor will forfeit a penalty to the City of St. Charles of $2,500 plus an additional $100 for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training.

Contractor acknowledges award of this City Contract requires compliance with Section 208.009 RSMo. Which requires Contractor to provide City with affirmative proof that he/she is a citizen or permanent resident of the United States or is lawfully present in the United States prior to the City awarding Contractor with this contract.

Contractor acknowledges award of this Contract requires compliance with Section 285.530(2) RSMo. (Cumm. Supp. 2008) regarding enrollment and participation in a federal work authorization program with respect to all persons working in connection with the contracted services. Contractor represents and warrants that it is in compliance with Section 285.530 at the time of award of this Contract. A sworn affidavit and supporting documentation affirming participation in a qualified federal work authorization program and that Contractor does not knowingly employ any person who is an unauthorized alien in connection with the services to be performed pursuant to this Contract is attached to this Contract and incorporated herein by this reference.

SAMPLE

Every transient employer, as defined in Section 285.230 RSMo., must post in a prominent and easily accessible place at the work site a clearly legible copy of the following: (1) the notice of registration for employer withholding issued to such transient employer by the director of revenue; (2) proof of coverage for workers' compensation insurance, or self-insurance, signed by the transient employer and verified by the department of revenue through the records of the division of workers' compensation; and (3) the notice of registration for unemployment insurance issued to such transient employer by the division of employment security. Any transient employer failing to comply with these requirements shall, under Section 285.234 RSMo., be liable for a penalty of $500 per day until the notices required by this section are posted as required by statute.

ARTICLE 9. The City reserves the right to audit, examine and to make copies of or extracts from all finance related records regarding the Contract kept by or under the control of the Vendor, including, but not limited to those kept by its employees, agents, assigns, successors and subcontractors.

ARTICLE 10. Nondiscrimination: Contractor agrees in the performance of this agreement that Contractor, and any subcontractor to the agreement, will not discriminate against any employee or applicant for employment, in the selection and retention of subcontractors, or in procurement of materials and leases of equipment with regard to the work performed during this agreement, on the basis of race, creed, color, age, sex, national origin, ancestry, religion, or political opinion or affiliation.

IN WITNESS WHEREOF the parties have to hereto executed this Agreement the date of the year first above written.

[CONTRACTOR]:

_____
Date

By:_____
(Print Name & Title)

Corporate Attest (if applicable):

_____
By: Date

CITY OF SAINT CHARLES, MISSOURI:

_____
By: Daniel J. Borgmeyer, Mayor Date

Attest:

_____
City Clerk Date

CERTIFICATE OF DIRECTOR OF FINANCE

I certify that the expenditure contemplated by this document is within the purpose of the appropriation and the work program contemplated thereby, and that there is a sufficient unencumbered balance in the appropriation account and in the proper fund to pay the obligation.

_____
Director of Finance Date

SAMPLE

SAMPLE

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SECTION 00 7300 – SUPPLEMENTARY CONDITIONS

1. Payments:
    a. Provided that a draft Application for Payment is received electronically by the Architect and the Owner's Representative not later than the 20th day of the invoicing month and subsequently recommended for approval, and the official Application for Payment is received by the Architect not later than the first day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the last day of the same month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than thirty (30) days after the Architect receives the Application for Payment. Notwithstanding the above, payments will be made as soon as practicable after the City Council meeting following receipt of the invoice. In no case will payment be delayed more than thirty (30) days. Moreover, if Owner is entitled to deduct damages or amounts provided in the Contract Documents, including clean-up fees, then Owner shall be entitled to deduct such damages, amounts and fees at any time (Federal, state or local laws may require payment within a certain period of time).
    b. Applications for Payments shall be submitted on AIA Documents G702 and G703. In the event of a dispute with regard to any item included in an Application for Payment, the Owner shall make payment for items not in dispute and shall have the right to withhold from payment the amount of such disputed item while the parties attempt to resolve the dispute in accordance with the dispute resolution provisions provided for in the Contract Documents.
        i. Such applications shall include:
            1. Certified payrolls, An original accounting of all labor rates and hours of Work .
            2. Invoices for all materials, rental equipment, and Contractor’s statements.
            3. Copies of Contractor’s daily log.
            4. Compliance with prevailing wage laws as per annual wage order issued with this contract.
            5. If invoicing for stored materials that have not been delivered to the project site, the following must be provided: proof of stored materials including certificate of insurance for facility where materials are stored, photographs of such materials, materials are labeled with signs indicating materials are “Property of The City of St. Charles, Missouri” and copies of invoices for materials from the vendors/supplier.
    c. For each monthly progress payment made prior to Substantial Completion of the Work, the Owner may withhold 10%, as retainage, from the payment otherwise due.
2. Owner’s Representative
    a. The Owner’s representative shall be:
        NAVIGATE Building Solutions
        9920 Watson Road, Suite 201
        St. Louis, MO 63126
    b. The Contractor shall cooperate with Owner’s representative to the same extent as the Owner.

3. Insurance and Bonds
    a. The Contractor shall secure and maintain at its own cost and expense and throughout the duration of this Contract and until the work is completed and accepted by the Owner, insurance of such types and in such amounts as may be necessary to protect it and the interests of the Owner against all hazards or risks of loss as hereunder specified or which may arise out of the performance of the Contract Documents. The form and limits of such insurance, together with the underwriter thereof in each case, are subject to approval by the Owner. Bid package requires AM Best rating of A-IX or higher. Regardless of such approval, it shall be the responsibility of the Contractor to maintain adequate insurance coverage at all times during the term of the Contract. Failure of the Contractor to maintain coverage shall not relieve it of any contractual responsibility or obligation or liability under the Contract Documents.
    b. Certificates of insurance, including evidence of the required endorsements hereunder or the policies, shall be filed with the Owner within ten (10) days after the date of the receipt of Notice of Award of the Contract to the Contractor and prior to the start of work. Work may not proceed until proof of all required insurance has been provided to the Owner. All insurance policies shall include an ISO Additional Insured Endorsement (CG 20 10 and CG 20 37 2004 editions or equivalent) listing the Owner and the Owner's Representative as additional insureds on a primary basis with owner and/or construction manager insurance excess and not contributory, general liability and auto to contain waiver of subrogation in favor of Owner and its officers, directors and employees, and an ISO Notice of Cancellation/Modification Endorsement providing thirty (30) days written notice to be given by the insurance company to the Owner prior to modification or cancellation of such insurance.
    c. Such notices shall be sent via email to the Owner's Representative AND the Owner directly.
    d. Minimum Coverages
        i. The minimum coverage for the insurance referred to herein shall be in accordance with the requirements established below:
        ii. Workers' Compensation: Statutory coverage per R.S.Mo. 287.010 et seq.; Employer's Liability: $1,000,000.00 for bodily injury each accident or disease, each employee for injury by disease.
        iii. Commercial General Liability Insurance: ISO occurrence form CG00010798 or later edition or equivalent substitute form. Including coverage for Premises, Operations Products and Completed Operations, Contractual Liability, Broad Form Property Damage, Independent Contractors, Explosion, Collapse, and Underground Property Damage and endorsed for blasting if blasting required. Such coverage shall apply to Bodily Injury and Property Damage on an "Occurrence Form Basis" with limits of Three Million Dollars ($3,000,000.00) for all claims arising out of a single accident or occurrence, Three Million Dollars ($3,000,000.00) for products/completed operations and One Million Dollars ($1,000,000.00) for any one person in a single accident or occurrence/advertising injury. Aggregate limits to apply separately to the Project other than completed

operations hazards. ISO CG 25 03 endorsement for general aggregate limit of Three Million Dollars ($3,000,000.00).

iv. Automobile Liability Insurance: ISO CA0001, CA0002, CA0005, CA0020 or equivalent. Covering Bodily Injury and Property Damage for owned, non- owned and hired vehicles with limits of Three Million Dollars ($3,000,000.00) for all claims arising out of a single accident or occurrence.

v. Owner's and Contractor's Protective Liability Insurance, to protect the Owner, its agents, servants and employees from claims which may arise from the performance of this Contract, with limits of Three Million Dollars ($3,000,000.00) for all claims arising out of a single accident or occurrence and Five Hundred Thousand ($500,000.00) for any one person in a single accident or occurrence.

vi. The Owner's and Contractor's Protective Liability Insurance must:
    1. be a separate policy with the named insured being the Owner;
    2. be with the same insurance company with which the Contractor carries its Commercial General Liability Insurance and Automobile Liability Insurance; and
    3. contain an endorsement that disclaims coverage for any claim barred by the doctrines of sovereign immunity or official immunity, except attorney's fees and other litigation costs incurred in defending a claim. Nothing contained in this policy (or this endorsement thereto) shall constitute any waiver of whatever kind of these defenses or sovereign immunity or official immunity for any monetary amount whatsoever.

vii. All-Risk Builders Risk Insurance: Unless specifically authorized by the Owner, the amount of such insurance shall not be less than the total contract price. The policy shall name as insured the Contractor and the Owner.

viii. Umbrella Excess: Two Million Dollars ($2,000,000) per occurrence and aggregate over employer's liability, general liability, and auto liability, with "follow-form" of underlying policies.

e. The Contractor shall require all subcontractors to procure and maintain all insurance required in this section and in like amounts and shall provide evidence of such insurance, with the following exceptions:
    i. Subcontractors are not required to provide All-Risk Builders Risk Insurance;
    ii. Subcontractors with an initial contract amount less than $100,000.00 may provide liability coverage limits of $1,000,000.00 in addition to a $1,000,000.00 umbrella policy;
    iii. Subcontractors need not carry OCPL coverage if contractor's coverage is inclusive;
    iv. The Contractor and/or subcontractor shall furnish the Owner prior to beginning any work satisfactory proof of carriage of all the insurance required by this Contract, with the provision that policies shall not be canceled, modified or non-renewed without thirty (30) days written notice to the Owner.

f. Pending Legislation
    i. If the scope or extent of the Owner's tort liability as a governmental entity as described in Section 537.600 through 537.650 R.S.Mo. is broadened or increased during the term of this agreement by legislative or judicial action, the Owner

requires the Contractor, upon 10 days written notice, to execute a contract addendum whereby the Contractor agrees to a price not exceeding Contractor's actual increased premium cost, additional liability insurance coverage as may require to protect the Owner from increased tort liability exposure as the result of such legislative or judicial action. Any such additional insurance coverage shall be evidenced by an appropriate certificate of insurance and shall take effect within the time set forth in the addendum.

4. Compliance with Laws:
    a. The Contractor shall comply with all local, state, and federal laws, rules, and regulations applicable to the provision of services and products under the Contract, including but not limited to: the Americans with Disabilities Act, employment discrimination laws, wage and hour laws (including as required by Sections 290.210 et seq. R.S.Mo.), the transient employer financial assurance law (Sections 285.230 et seq. RSMo.), and public contracting laws. The Contractor affirmatively states that payment of all local, state, and federal taxes and assessments owed by the Contractor is either current or under lawful protest with the applicable taxing jurisdiction.
    b. Not less than the prevailing hourly rate of wages specified under Section 290.210-290.340 of the Revised Missouri Statues and set out in the Wage Determination shall be paid to all workers performing Work under this Contract. The Contractor shall forfeit as provided in Section 290.250 of the Revised Missouri Statutes as a penalty to the Owner the sum of One Hundred Dollars ($100.00) for each worker employed, for each calendar day, or portion thereof, that such worker is paid less than the prevailing rate for any work done under said Contract by the Contractor or by any of its Subcontractors.
5. Certified Payroll:
    a. The Contractor & each Subcontractor are required to submit, WEEKLY, ONE (1) Certified ORIGINAL for each week that work is in progress & SHOULD BE NUMBERED SEQUENTIALLY. If work is temporarily suspended, the last payroll should be appropriately marked to note that it would be the last payroll until work is resumed. Submitter shall make sure that each payroll is numbered and dated, includes the name of the Project on it as well as the name of the Subcontractor. It is important that submitter number ALL payrolls sequentially. This will keep Contractor from having to send "No Work" payrolls when no hours are logged for a pay period. It will also make it easier to track and communicate any inconsistencies. Submitter shall label each of the "Final Payrolls" from each contractor/subcontractor as such.
    b. The Contractor must submit one (1) certified originals of each weekly payroll within 7 days of the payment date of the payroll. The certification may be attached to the payroll or may be on the payroll itself. The Contractor will be considered responsible for submittal of payrolls and certifications for all their sub recipients on the project. The certification must be properly signed originals. Electronic submittal of certified payrolls is not permitted. Failure to submit these payrolls within the 7-day period will result in delay in submittal of pay applications. All certified payrolls must be certified by an officer of the company only. Contractor cannot certify several pay periods with only one payroll certification. This is unacceptable to the Department of Labor. Each certification must also be dated and signed to be valid. Owner would prefer that the certification be signed in a

color other than black. Owner can accept Xeroxed payrolls; however, the certifications must each be signed with an original, live signature. THE OWNER CANNOT ACCEPT COPIED SIGNATURES ON THE PAYROLL CERTIFICATIONS. The employee's full name must be used. Addresses are not optional and MUST be listed on publicly funded projects such as this one. Social Security numbers are no longer allowed on certified payrolls, however, in lieu of the Social Security number; the contractor must assign the employee an identification number and place that identification number on the certified payroll. The identification number can be the last four digits of the employee's Social Security number. Employers (prime contractors and subcontractors) must maintain the current address and full SSN for each employee and must provide this information upon request to the contracting agency or other authorized representative responsible for labor standards compliance. All deductions must be clearly identified. Only approved deductions should be used in wage rate calculations as per the Code of Federal Regulations. The US Department of Labor Form LS-57 may be used, as this form complies with all code requirements. If any part of the payroll or payroll certification is illegible or not completely filled out, they will be returned to your office for correction and re-submission. IMPORTANT NOTE: APPRENTICE CERTIFICATION LETTERS MUST ACCOMPANY CERTIFIED PAYROLLS THE 1ST TIME THEIR NAME APPEARS ON A CERTIFIED PAYROLL-IF NOT ATTACHED IT WILL DELAY APPROVAL OF CERTIFIED PAYROLL, AND THEREFORE PAY APPLICATION SUBMISSION.

c. Unauthorized Alien Act Compliance and Federal Work Authorization Program Enrollment - No business or entity involved with this project shall employ an unauthorized alien to perform work within the state of Missouri. As a condition for the award of any contract or grant in excess of $5,000.00, the business entity shall, by sworn affidavit and provision of documentation, affirm its enrollment and participation in a federal work authorization program (for example, the so called Federal E-Verify Program) with respect to the employees working in connection with the contracted services (see section 285.530 RSMo, enclosed in the laws section).To reaffirm - All Contractors are required to obtain and make available for inspection by the contracting public body from each subcontractor of any tier, an original sworn affidavit which affirms, under penalty of perjury, that the subcontractor is enrolled & actively participating in a federal work authorization program, that the subcontractor does not knowingly employ any person who is an Unauthorized Alien in connection with the contracted services, and the subcontractor's employees are lawfully present in the United States. The Contractor shall comply with all applicable federal, state & local labor laws & is not knowingly in violation of §RSMo 285.530(1) and shall not henceforth be in such violation. This shall appear in contracts between the general contractor and subcontractors and contracts between subcontractors of any tier.

6. Liability and Indemnity:
    a. In no event shall the Owner be liable to the Contractor for special, indirect, or consequential damages, except those caused by the Owner's willful misconduct arising out of or in any way connected with a breach of this Contract. The maximum liability of the Owner shall be limited to the amount of money to be paid by the Owner under this Contract.

b. The Contractor shall defend, indemnify, and hold harmless the Owner, its elected or appointed officials, Architect, Owner's Representative, and their respective consultants, insurers, agents, and employees, from and all liability, suits, damages, costs (including attorney fees), losses, outlays and expenses from claims caused by, or allegedly caused by, or arising out of or connected with, this Contract, or the work of tract hereunder (the Contractor hereby assuming full responsibility for relations with subcontractors), including but not limited to claims for personal injuries, death, or property damage (other than the Work itself), regardless of whether the loss to be indemnified was caused in part by an indemnified person.
c. The Contractor shall indemnify and hold the Owner harmless from all wages or overtime compensation due any employees in rendering services pursuant to the Contract or any subcontract, including payment of reasonable attorneys' fees and costs in the defense of any claim made under the Fair Labor Standards Act, the Missouri Prevailing Wage Law or any other federal or state law.
d. By executing this Contract, the Contractor represents that the Contractor has reviewed the Contract Documents and affirms that the Contractor is not aware of any material defects in said documents that might prevent the Contractor from completing the Work and the Project as promised herein. The Contractor accordingly waives any claim of such material defect against the Owner.
e. Contractor stipulates that Owner is a political subdivision of the State of Missouri, and as such, enjoys immunities from suit and liability as provided by the Constitution and laws of the State of Missouri. By entering into this Agreement, Owner does not waive any of its immunities from suit and/or liability, except as otherwise specifically provided herein and as specifically authorized by law.
f. The Contractor may not assign its responsibilities, duties, obligations and rights under this Agreement, without the express written consent of the Owner. This does not prevent Contractor from engaging subcontractors to perform various phases of the Project, but Contractor shall be fully responsible to Owner for the work, actions and omissions of all such subcontractors.
g. This Agreement, in its entirety, shall be binding upon all the parties hereto, their respective successors, heirs, executors, administrators or assigns.
h. No delay or omission by either of the parties hereto in exercising any right or power accruing upon the noncompliance or failure of performance by the other party hereto of any of the provisions of this Agreement shall impair any such right or power or be construed to be a waiver thereof. A waiver by either of the parties hereto of any of the covenants, conditions or agreements hereof to be performed by the other party hereto shall not be construed to be a waiver of any subsequent breach thereof or of any other covenant, condition or agreement herein contained.

7. Contractor's Responsibility for Subcontractors
   a. The Contractor shall be as fully responsible to the Owner for the acts and omissions of its Subcontractors, and of persons either directly or indirectly employed by them, as Contractor is for the acts and omissions of persons it directly employs. The Contractor shall cause appropriate provisions to be inserted in all subcontracts relating to this work to bind all Subcontractors to Contractor by all the terms herein set forth, insofar as

applicable to the work of Subcontractors, and to give Contractor the same power regarding termination of any subcontract as the Owner may exercise over the Contractor under any provisions of this Contract. Nothing contained in this Contract shall create any contractual relation between any Subcontractor and the Owner or between any Subcontractors.

b. The Contractor shall enforce the Owner's alcohol-free, drug-free, tobacco-free, harassment-free and weapon- free policies and zones, which will require compliance with those policies and zones by Contractor's employees, subcontractors, and all other persons carrying out the Contract.

8. Conflicts:
    a. Contractor covenants that it has no interest and shall not acquire any interest, direct or indirect, that would conflict in any manner or degree with the performance of services to be performed under this Contract. The Contractor further covenants that the performance of Contract no person having such interest shall be employed.
    b. No salaried officer, employee or elected official of the Owner shall have a financial interest, direct or indirect, in this Contract. A violation of this provision renders the Contract void. Any federal regulations and applicable provisions in Section 105.450 et seq. RSMo. shall not be violated.
9. Assignment:
    a. Contractor shall not assign or transfer any interest in this Contract (whether by assignment or novation), and shall not substitute any specific individuals and/or personnel qualifications without prior written consent of the Owner, except that claims for money due or to become due to the Contractor from the Owner under this Contract may be assigned to a bank, trust company, or other financial institution without such approval, but notice of such assignment or transfer shall be furnished in writing promptly to the Owner. Any such assignment is expressly subject to all rights and remedies of the Owner under this agreement, including the right to change or delete activities from the Contract or to terminate the same as provided herein, and no such assignment shall require the Owner to give any notice to any such assignee of any actions which the Owner may take under this agreement, though Owner will attempt to so notify any such assignee.

10. General Independent Contractor Clause:
    a. This Contract does not create an employee/employer relationship between the parties. It is the parties' intention that the Contractor will be an independent contractor and not the Owner's employee for all purposes, including, but not limited to, the application of the Fair Labor Standards Act minimum wage and overtime payments, Federal Insurance Contribution Act, the Social Security Act, the Federal Unemployment Tax Act, the provisions of the Internal Revenue Code, Missouri revenue and taxation laws, Missouri workers' compensation and unemployment insurance laws subject to the provisions of this Contract, the Contractor will retain sole and absolute discretion in the judgment of the manner and means of carrying out the Contractor's activities and responsibilities hereunder. The Contractor agrees that it is a separate and independent enterprise from the Owner, that it has a full opportunity to find other business, that it has made its own investment in its business, and that it will utilize a high level of skill necessary to perform the work. This agreement shall not be construed as creating any joint employment relationship between the Contractor and the Owner, and the Owner will not be liable for any obligation incurred by the Contractor, including but not limited to unpaid minimum wages and/or overtime premiums.

END OF SECTION

Missouri
Division of Labor Standards
WAGE AND HOUR SECTION

MICHAEL L. PARSON, Governor

Annual Wage Order No. 27

Section 092
ST. CHARLES COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by
Taylor Burks, Director
Division of Labor Standards

Filed With Secretary of State: **March 10, 2020**

Last Date Objections May Be Filed: **April 9, 2020**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	$62.68
Boilermaker	$68.96
Bricklayer	$57.72
Carpenter	**$51.21**
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	$51.13
Plasterer	
Communications Technician	**$56.18**
Electrician (Inside Wireman)	**$64.05**
Electrician Outside Lineman	$69.60
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	*$27.58
Glazier	**$62.12**
Ironworker	$62.08
Laborer	**$46.56**
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	**$52.15**
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	**$61.64**
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	**$49.08**
Plumber	**$69.83**
Pipe Fitter	
Roofer	**$51.62**
Sheet Metal Worker	**$67.05**
Sprinkler Fitter	**$71.91**
Truck Driver	*$27.58
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received less than 1,000 reportable hours for this occupational title.
Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.
**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

Heavy Construction Rates for
ST. CHARLES County

REPLACEMENT PAGE

Section 092

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	**$56.91**
Millwright	
Pile Driver	
Electrician (Outside Lineman)	$69.60
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	**$48.30**
General Laborer	
Skilled Laborer	
Operating Engineer	**$62.15**
Group I	
Group II	
Group III	
Group IV	
Truck Driver	**$42.89**
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received less than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME
and
HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, **"overtime work"** shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January First;
The last Monday in May;
July Fourth;
The first Monday in September;
November Eleventh;
The fourth Thursday in November; and
December Twenty-Fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

DIVISION OF LABOR STANDARDS

MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

MISSOURI PUBLIC WORKS PROJECTS CONTRACTOR CHECK-OFF LIST

The Division of Labor Standards (DLS) is providing this check-off list to assist contractors in being compliant with Missouri's labor laws applicable to public construction projects. The Prevailing Wage Law requires that not less than the locally prevailing wages be paid to workers on every construction project in the state that is for the public use or benefit or that uses public funds. Failure to comply with the Prevailing Wage Law may constitute a misdemeanor for the employer and for the public official that does not fulfill the responsibilities it imposes. The Construction Safety Training Act mandates that all employees working on the site of public works construction projects must have received safety training.

I
Before Contract Is Let

☐ The annual wage order obtained from the DLS website (www.labor.mo.gov/DLS/PrevailingWage) must be made a part of the specifications for the work to be performed under the contract (Section 290.250 and 290.325, RSMo).

II
While Contract Is Being Performed

☐ All workers performing work under a public construction contract must be paid not less than the prevailing hourly rate of wages (as set out in the annual wage order attached to and made part of the specification for work under the contract). (Section 290.250, RSMo).

The contractor will forfeit a penalty to the contracting public body of $100 per day (or portion of a day) for each worker that is paid less than the prevailing rate for any work done under the contract by the contractor or by any subcontractor (Section 290.250, RSMo). For detailed information on rules and occupational titles, see 8 CSR 30-3.010 through 3.060.

☐ The contractor and all subcontractors to the contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292.675, RSMo, if they have not previously completed the program and have documentation of having done so.

The contractor will forfeit a penalty to the contracting public body of $2500 plus an additional $100 for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training. (Section 292.675, RSMo).

☐ A legible list of all prevailing wage rates **must remain posted** in a prominent and easily accessible place at the worksite by each contractor and subcontractor on the project. The notice must be posted during the full time that any worker is employed on the job (Section 290.265, RSMo).

☐ The payroll records required to be so kept shall be open to inspection by any authorized representative of the contracting public body or of DLS at any reasonable time and as often as may be necessary and such records shall not be destroyed or removed from the state for the period of one year following the completion of the public work in connection with which the records are made (Section 290.290, RSMo). DLS provides a Contractor Payroll Records form (LS-57) for contractors and subcontractors to use to assure provision of the payroll information required (8 CSR 30-3.010[7]).

III
Before Contract Is Fully Paid

☐ Before final payment can be made, the general contractor and all subcontractors **must** file an **Affidavit of Compliance** (PW-4) with the contracting public body. The affidavit must affirm under oath that the party has fully complied with Missouri Prevailing Wage Law, and the public body must verify that the correct wages were paid. No payment can be legally made by the public body to the contractor(s) until the affidavit is filed in proper form and order with the public body (Section 290.290 and 290.325, RSMo).

☐ It shall be lawful for any contractor to withhold from any subcontractor under him sufficient sums to cover any penalties withheld from him by the awarding body on account of any such subcontractor's failure to comply with the terms of sections 290.210 to 290.340, and if payment has already been made to him, the contractor may recover from the subcontractor the amount of the penalty in a suit at law (Section 290.250.1, RSMo).

Failure to comply with the requirements of the Prevailing Wage Law can result in civil action, including an injunction stopping work on a project, and in criminal fines of up to $500 and up to six months imprisonment for **each day** there is a violation.

Missouri Department of Labor and Industrial Relations
Division of Labor Standards
Prevailing Wage Section
P.O. Box 449
Jefferson City, MO 65102-0449
Phone: 573-751-3403
Fax: 573-751-3721

Email: prevailingwage@labor.mo.gov

Website: www.labor.mo.gov/DLS/prevailingwage/

Missouri Department of Labor and Industrial Relations is an equal opportunity employer/program.
TDD/TTY: 800-735-2966 Relay Missouri: 71

MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
DIVISION OF LABOR STANDARDS

INSTRUCTION SHEET FOR LS-57 (CONTRACTOR PAYROLL RECORDS)

P.O. Box 449
Jefferson City, MO 65102-0449
Phone: 573-751-3403
Fax: 573-751-3721

Contractor or Subcontractor: Fill in your firm's name and check appropriate box.

Address: Fill in your firm's address and noted information.

Name of Public Body: Name of public entity for which work is being performed or who issued contract.

Address: Address of public entity.

Payroll No.: Begin with payroll No. 1.
Payroll reports must be submitted each week. If work was not performed in specified week, note "No Work".

For Week Ending: List the workweek ending date.

AWO: Indicate Annual Wage Order Number.

Project and Location: Name of Project/Project Location.

Project or Contract No.: Indicate Project Number or Contract Number.

1. **Name and Address of Employee:** List workers that worked on project for the listed week. Enter each worker's full name and address on weekly payroll. **Both the name and address must be listed.**

2. **Occupational Title:** List the occupational title of each worker. A worker may perform work under different occupational titles. The employer must keep accurate records showing the breakdown of hours worked for each occupational title. For a list of occupational titles, visit http://www.sos.mo.gov/adrules/csr/current/8csr/8c30-3.pdf.

3. **Day and Date:** List day of week in the top row (Su – M – Tu – W – Th – F – Sa), begin with the first day of the pay period. List calendar date in the bottom row (1, 2, 3, 4, 5, 6, 7…).

   Hours worked: Record number of hours worked per day.
   Straight Time (ST), Overtime (OT), Double Time (DT), if applicable.

4. **Total Hours:** Total hours worked for the listed week on this project.

5. **Hourly Rate of Pay:** List the actual hourly rate paid for straight time worked. When overtime is worked, show the overtime hourly rate paid in the "Overtime" box for each worker.

6. **Gross Amount Earned:** TOP CORNER – Project gross amount earned this pay period, on this project for the listed week. LOWER CORNER – Week total gross amount earned during week for work on all projects. If part of a worker's weekly wage was earned on projects other than the project described on given payroll, then the gross amount earned is gross earned for the week on all projects (example:

"$163/$420" would reflect a worker who earned $163 on a public works construction project and a total of $420 from all work performed for the listed week, including the public works project).

7. **Deductions:** Complete all required deductions. List any additional deductions in the "Other" column. Add all deductions, and place total in the "Total Deductions" column. On page 2 of the form, describe the deduction(s) contained in the "Other" columns in the space provided. If an individual worked on other jobs in addition to this project, show actual deductions from the weekly gross wage.

8. **Net Wages Paid for Week:** Net wages paid for the listed week on all projects. This is the take-home amount for the week.

Page Two (Back of Form)

Required Statement: An authorized agent of the contractor or subcontractor must complete and sign the "statement of compliance." The entry of any false information in this form will result in the agent and the contractor or subcontractor being subject to criminal prosecution and penalties under §§ 290.340, 575.050, 575.060, and 575.080, RSMo.

DIVISION OF LABOR STANDARDS

MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

CONTRACTOR PAYROLL RECORDS

(See Sections 290.210 to 290.340, RSMo and 8 CSR 30-3.010 to 8 CSR 30-3.060)

Name of ☐ Contractor ☐ Subcontractor	Address of Contractor or Subcontractor: City: State: ZIP: Phone Number: ( ) -
Name of Public Body	Address of Public Body: City: State: ZIP: Phone Number: ( ) -

Payroll No.	For Week Ending / /	AWO	Project and Location	Project or Contract No.

1. Name and Address of Employee	2. Occupational Title ***	3. Day and Date Day / Date Hours Worked Each Day	4. Total Hours	5. Hourly Rate	6. Gross Amt Project / Week	7. Deductions: FICA and Medicare	Federal and State Withholding Tax	Other A	Other B	Total Deductions	8. Net Wages Paid for Week
		DT									
		OT									
		ST									
		DT									
		OT									
		ST									
		DT									
		OT									
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****** If a worker performs work in more than one occupational title, you must separately list the hours worked per occupational title and wage rates. ******

FRINGE BENEFITS

In addition to the basic rates paid to each laborer or mechanic on the payroll, payments have been or will be made to appropriate programs for the benefit of these employees as shown in the following chart below. If fringe benefit amounts paid are the same for all employees, you may list the amount of each such identical fringe payment only once in the appropriate column; if the fringe benefit amounts vary by employee, list each employee's name and set out the amounts paid on behalf of each employee for each fringe benefit.

Employee Name	Health and Welfare ($/hr)	Pension ($/hr)	Vacation ($/hr)	Holiday ($/hr)	Appren-tice Training ($/hr)	Other C ($/hr)	Other D ($/hr)	Total ($/hr)	If "Other/Deduction" or Fringes, please explain. (Indicate Other A, B, C or D)	Identify by name, the plan, fund, or programs to which fringe benefits are paid. (Indicate H&W, Pension, etc.)

Date: _____

I, _____ *(Name of Signatory Party)*, _____ *(Title)* do hereby state:

(1) That I pay or supervise the payment of the persons employed by _____ *(Contractor or Subcontractor)* on the _____ *(Building or Work)*; that during the payroll period commencing seven (7) days prior to the week ending date of _____ all persons employed on said project have been paid the full weekly wages stated above, that no rebates have been or will be made either directly or indirectly to or on behalf of _____ *(Contractor or Subcontractor)*, from the full weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than legally permissible deductions, that full and accurate records clearly indicating the names, occupations, and crafts of every worker employed by them in connection with the public work together with an accurate record of the number of hours worked by each worker and the actual wages paid for each class or type of work performed and deduction made for each worker have been prepared, that these payroll records are kept and have been provided for inspection to the authorized representative of the contracting public body and will be available as often as may be necessary and such records shall not be destroyed or removed from the state for the period of one year following the completion of the public work in connection with which the records are made.

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage order incorporated into the contract; that the occupational title set forth herein for each laborer or mechanic conform with the work performed.

Name and Title	Signature
The falsification of any of the above statements may subject the contractor or subcontractor to criminal prosecution. See Sections 290.340, 570.090, 575.050, and 575.060, RSMo.	

Missouri Department of Labor and Industrial Relations is an equal opportunity employer/program.
TDD/TTY: 800-735-2966 Relay Missouri: 711

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Access to site.
5. Coordination with occupants.
6. Project Supervision
7. Work restrictions.
8. Specification and drawing conventions.

B. Related Section:
1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Architect’s project number 20-035
1. Project Location: 2871 Elm Point Industrial Drive

B. Owner: City of St. Charles

C. Architect: H Design Group LLC, 5039 S. National Avenue, Springfield, Missouri 65810

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and project manual

1.4 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.5 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.6 PROJECT SUPERVISION

A. Resident Superintendent: General Contractor shall provide superintendent for the entire project duration to oversee subcontractors and suppliers. Project superintendent shall not be changed during the project unless approved by owner.

B. Superintendent job requirements/qualifications:
1. Knowledge of type of construction and experience in similar size projects
2. Ability to understand and follow plans/specifications in the construction of project.

3. Knowledge of the construction techniques and sequencing of subcontractors scope of work.
4. Ability to organize and schedule subcontractors/suppliers effectively during the project duration to meet predefined schedule.
5. Ability to implement and enforce safety regulations for all workers.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's permission before proceeding with disruptive operations.

C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections..
2. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

END OF SECTION 011000

BILL OF SALE

SELLER: _____
_____
_____

In consideration of payments made by The City of St. Charles ("Buyer") referenced in the agreement dated _____, 20____, receipt of which is hereby acknowledged, Seller declares and certifies that it now possesses, and does hereby grant, sell, transfer and deliver to Buyer all right, title and interest in the following goods:

Buyer to have all right and title to the goods in himself and his executors, administrators and assigns forever and Seller, on behalf of itself, its successors and assigns, will warrant and defend the title to said goods and chattels hereby sold unto Buyer, its successors and assigns, forever, against the lawful claims and demands of all persons. It is expressly understood and agreed that the acceptance of the goods described herein is not a waiver of any right of action that the Buyer may have for breach of warranty or any other cause under the agreement referenced above or at law.

IN WITNESS WHEREOF, Seller has executed this Agreement the ____ day of _____, 20____.

Seller: _____

By: _____

Title: _____

Subscribed and sworn to before me this ____ day of _____, 20____.

_____
Notary Public

My commission expires:

_____

BAILMENT AGREEMENT

BAILOR: Owner
The City of St. Charles
200 N. Second Street
St. Charles, MO 63301

BAILEE: Contractor/Supplier
_____
_____
_____

LOCATION OF STORAGE:

The goods and materials described below are held and stored at the above referenced location pursuant to the Contract by and between Bailee, as Contractor/Supplier, and _____, as Contractor, for Work to be performed at the St. Charles Public Works Facility Addition Project located at _____. In consideration of payment made to the undersigned Bailee, the receipt and sufficiency of which are admitted, the Bailee agrees:

1. to keep said goods and materials at the above mentioned address, separate and apart from all other goods and identified as subject to this bailment,

2. to keep said goods and materials fully insured against all risk of physical loss or damage,

3. to keep said goods protected from the weather, commingling, vandalism and/or diversion from said Project, and

4. to deliver said goods and materials to the Project site in conjunction with the performance of Bailee's Contract referenced above or upon the direction of Bailor or its Contractor and no other. The Bailee acknowledges that it has no ownership rights or title in, nor shall claim any lien upon, said goods and materials.

QUANTITY	DESCRIPTION OF ITEM

Receipted and Acknowledged:

Contractor/Supplier (Bailee)

Dated:_____ By:_____
Authorized Signature

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:
   1. Owner allowances.

C. Related Requirements:
   1. Division 01 Section "Unit Prices" for procedures for using unit prices.
   2. Division 01 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
   3. 01 2600.01 – Modification / Explanation to the Change Order Fee.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.3 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.4 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 OWNER ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the Owner allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the Owner allowance will include Contractor's related costs and overhead and profit margins as allowed per specification 01 2600.1.

D. At Project closeout, credit unused amounts remaining in the Owner allowance to Owner by Change Order.

1.7 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.

4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
   1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
   2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Owner Allowance: Include the sum of $50,000 (Fifty-thousand dollars.
   1. This allowance includes material cost, receiving, handling, installation, and Contractor overhead and profit.
   2. Coordinate quantity allowance adjustment with corresponding unit-price requirements in Division 01 Section "Unit Prices."

END OF SECTION 012100

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitution requests for acceptance of products not indicated as approved equal in the specifications or construction drawings.

B. Related Section:
1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor, subcontractors and suppliers.

1.3 SUBMITTALS

A. Substitution Requests: During bidding contractor, subcontractors and suppliers shall be allowed to submit documentation for approval for products and manufacturers not specified as part of these specifications or construction drawings unless noted otherwise. Any product submitted during shop drawing process that has not been formally approved will be reviewed by the architect and engineer for compliance with the original specified product. If the architect or engineer disapproves the product substitution request, the Contractor will provide the product from approved list of acceptable manufactures at no additional cost to project.

B. Substitution Requests must be submitted no later than 7 days prior to bid date for Architect and/or Engineer review.

C. Submit substitution request form per section 012600 with the following documentation.
1. Show compliance with requirements for substitutions and the following, as applicable.
    a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    b. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    d. Samples, where applicable or requested.
    e. Certificates and qualification data, where applicable or requested.
    f. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    g. Research reports evidencing compliance with building code in effect for Project.

h. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
i. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
j. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
k. Architect and/or Engineers Action: Architect and/or engineer will review substitution request forms and data to ensure they meet the design intent per the original plans and specifications. If approved the product and manufacture will be formally approved on addendum prior to bid date.
l. Approved substitutions shall not limit the features or color selections of the specified product unless formally approved by architect and/or engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - SUBSTITUTION REQUEST FORM

This form is to be used to submit product(s) for Architect or Engineers approval five (5) business days prior to bids being submitted. Submit this document to Architect per section 012500.

To: _____

We hereby submit for your consideration the following product instead of the specified items for the above project:

Specification Section: _____

Proposed Substitution: _____

Attach complete Product description, drawings, photographs, performance and test data, and other information necessary for evaluation.

A. Will changes be required to building design in order to properly install proposed substitution?

YES ____ NO ____

If yes, explain _____

B. What difference exists between proposed substitution and specified item?

_____

C. Does manufacturer's warranty of proposed substitution differ from that specified?

YES ____ NO ____

If yes, explain _____

D. Will maintenance and service parts be locally available for substitution?

YES ____ NO ____

If yes, explain _____

_____
COMPANY NAME

_____
CONTACT PERSON TELEPHONE

END OF SECTION 012600

01 2600.1 - Modification/Explanation to the Change Order Fee

1. The maximum that will be allowed for overhead and profit on changes in work shall be as follows, expressed as a percentage of the basic cost of the change. The allowable percentages for profit or overhead may be less, depending on the nature, extent or complexity of the change, where the percentage is not commensurate with the responsibility and administration involved (such as the Contractor merely processing substantial Change Order to a Subcontractor) but in no event shall they exceed the following:
    a. To the Contractor and/or its Subcontractor for work performed with their own forces 12%
    b. To the Contractor for work performed by other than its own forces 5%
    c. To the Subcontractor/Supplier for work performed with their own forces 12%
    d. To the Subcontractor/Supplier for work performed by other than its own forces 5%

2. Not more than above specified percentages for overhead, profit and commission will be allowed to be added to the basic cost, regardless of the number of tiers of Contractors, Subcontractors or Sub-subcontractors.

3. The burden on labor may be indicated as a dollar/cents addition to the hourly rate or may be expressed as a percentage of the extended hourly rate costs. If required by the Owner, the Contractor shall provide a detailed breakdown to justify the labor burden. The Owner reserves the right to reject any labor burden which is inconsistent with other similar contractors or where the cost of fringe benefits are in excess of established labor agreements.

4. Material, equipment, and supply costs shall be quoted at the actual cost to the Contractor, or Subcontractor. Upon request, the Contractor (or Subcontractor) shall submit evidence to substantiate the costs. Said costs shall be quoted at trade discount prices, with quantity discounts also applied where the quantities warrant. In any proposal with material, equipment and supply credit, the credit shall be based on the actual Contract cost of the material (including trade and quantity discounts) less any charges actually incurred for handling or returning a material which has been delivered.

5. The percentages allowed for overhead and profit herein shall be deemed to include, and no further addition allowed the Contractor, Subcontractor or Sub-subcontractors for: (1) field and office supervision and administration, including the field superintendent and non-working foremen; (2) general insurance; (3) use or replacement of tools; (4) shop burden; (5) engineering costs; (6) performance (guaranty) and labor/material payment bonds; (7) cost of safety measure (including those imposed by OSHA); (8) permits, unless a new permit type is required, and (9) warranty costs.

6. Cost changes shall be computed by determining the basic costs enumerated below (as further specified under this Subparagraph), to which the overhead may be added, then the profit figure may be added, and finally adding the sales tax on materials if allowable.

7. For changes in the Work, the cost shall be determined as provided under this section. The Contractor shall submit an itemized list of quantities with the applicable unit costs and extended price for each, in such form and detail as required by the Owner. As a minimum, the detailed breakdown shall include and indicate the items enumerated below. Items (a) and (b) constitute the cost of labor, and items (a), (b), (c) and (d) constitute the basic costs referred to under this section.

    a) Labor costs, itemized by each trade involved, showing the hourly rates for each, and the hours required for the change. Labor rates shall be the same for extra and credit computations and shall be the actual rate paid the workmen in accordance with established management labor agreements.
    b) Burden on labor, which shall be only the actual costs of mandatory fringe benefits required by established agreements, taxes on labor, worker's or workmen's compensation, insurance on labor as affected by payroll, unemployment taxes and insurance, including FICA and FUTA. No other costs will be allowed as burden on labor.
    c) Quantities of materials, equipment, and supplies, at their actual costs, with unit costs indicated.
    d) The cost of subcontracted work computed in the same way as provided for under this section.
    e) Overhead, profit and commission as set forth herein.
    f) Applicable sales tax on materials, added after the above computations are complete.

8. Subcontractors (or Sub-subcontractors) shall compute their costs in the same way and are subject to the same conditions of what may be included in the cost and the same maximum percentages for overhead and profit. To the Subcontractor's price, the Contractor may add up to a maximum of five percent (5%). For changes involving work of the Contractor with its own forces and work by a Subcontractor (or Sub-subcontractor), the commission shall be applied directly to the Subcontractor's price, with the overhead and profit figure applied only to the Work the Contractor performs with its own forces.

9. For changes involving both extra and credit amounts, the overhead and profit, or commission, shall be applied only to net difference where the extra exceeds the credit.

10. For changes resulting in a credit in the basic costs, a reasonable allowance for overhead, profit or commission may be required to be credited to the Owner, as approved by the Owner. In general, no credit for overhead, profit or commission will be required where the net change credit is minor or where the Change in Work indicates it is reasonable that no credit be allowed to the Owner due to the effort, cost or responsibility of the Contractor. In the event of substantial subcontract credits or for Work the Contractor does not provide or perform, a reasonable overhead, profit or commission credit shall be allowed to the Owner, as determined by the Owner.

11. If anytime, Contractor is directed to proceed in writing by the Owner or Owner’s Representative on a time and material basis for a change. The Contractor must notify Owner’s Representative when work is beginning, when it is complete and daily tickets must be submitted as backup documentation. Daily tickets to be signed daily and verified by the Contractor’s onsite superintendent and submitted daily to the Owner’s Representative. Any change order request submitted without these daily signed tickets will be rejected and will not be compensated.

12. Additional scope that is authorized to be completed on a T&M basis on behalf of the Owner, shall be documented as follows:
    a) Contractor shall issue daily tickets identifying hours worked, classification of worker, materials used, internally or externally rented equipment, and subcontractors utilized.
    b) The additional scope should be delineated from the base bid scope.
    c) Hours worked shall be verified by the General Contractor's Superintendent and/or Authorized Owner's Representative and indicated by signature on daily work tickets.
    d) There should be a separate ticket for each day that additional scope of work takes place.
    e) Unit costs, material costs and rental rates will be evaluated accordingly to typical market value.
    f) The contractor is responsible for expending costs with the Owner's best interest in mind.

END OF SECTION

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SECTION 012700 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on Architect's Supplemental Instructions.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
   2. Within ten days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
   1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   4. Include costs of labor and supervision directly attributable to the change.

5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Work Change Directive: Architect may issue a Work Change Directive on AIA Document G71 Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination drawings.
   2. Requests for Information (RFIs).
   3. Project meetings.

B. Related Sections:
   1. Division 01 Section "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
   2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information from each other during construction.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.

9. Project closeout activities.

1.4 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
   1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
   2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect.
   6. RFI number, numbered sequentially.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: AIA Document G716

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   1. The following RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for coordination information already indicated in the Contract Documents.
      d. Requests for adjustments in the Contract Time or the Contract Sum.
      e. Requests for interpretation of Architect's actions on submittals.
      f. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
   3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.5 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Architect will schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
a. Tentative construction schedule.
b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.
e. Procedures for processing field decisions and Change Orders.
f. Procedures for RFIs.
g. Procedures for testing and inspecting.
h. Procedures for processing Applications for Payment.
i. Distribution of the Contract Documents.
j. Submittal procedures.
k. Sustainable design requirements.
l. Preparation of record documents.
m. Use of the premises.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.

r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect**[,** of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written recommendations.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at intervals agreed to by all parties involved.

1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
        1) Review schedule for next period.
    b. Review present and future needs of each entity present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of proposal requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Contractor's construction schedule.
   2. Field condition reports.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. PDF electronic file.
   2. Paper copies (if requested).

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

C. Field Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from entities involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
   4. Startup and Testing Time: Include not less than 15 days for startup and testing.
   5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
   6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work under More Than One Contract: Include a separate activity for each contract.
   3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   4. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Provisions for future construction.
      g. Seasonal variations.
      h. Environmental control.
   5. Work Stages: Indicate important stages of construction for each major portion of the Work.
   6. Other Constraints:

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Unresolved issues.
   2. Unanswered RFIs.
   3. Rejected or unreturned submittals.
   4. Notations on returned submittals.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's construction schedule within 30 days of date established for commencement of the

Notice to Proceed**.** Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

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

END OF SECTION 013200

SECTION 013300 – ELECTRONIC SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections:
1. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
2. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
3. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ELECTRONIC SUBMITTAL PROCEDURES

A. SUMMARY:
1. Shop drawing and product data submittals shall be transmitted to Architect in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.
2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
3. The electronic submittal process is not intended for color samples, color charts, or physical material samples.

B. PROCEDURES:
1. Submittal Preparation – Contractor may use any or all of the following options:
a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the Submittal Exchange website.
b. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
c. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
2. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
3. Contractor shall transmit each submittal to Architect using the Submittal Exchange website, www.submittalexchange.com.
4. Architect / Engineer review comments will be made available on the Submittal Exchange website for downloading. Contractor will receive email notice of completed review.

5. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
6. Submit paper copies of reviewed submittals at project closeout for record purposes in accordance with Section 017800 – Closeout Submittals.

C. COSTS:
1. The cost of Submittal Exchange services shall be included in the General Contractors base bid price.
2. At Contractor's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 515-393-2422.
3. Internet Service and Equipment Requirements:
   a. Email address and Internet access at Contractor's main office.
   b. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
1. The Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings. See engineers specifications for any associated costs for their cad file drawings for this use.
   a. The Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

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

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architects receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 10 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS

A. General Submittal Procedure Requirements:
   1. Action Submittals: Submit per requirements below.
   2. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
   3. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams showing factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before or concurrent with Samples.
   6. Submit Product Data in the following format:
      a. PDF electronic file.
      b. Paper copies (only if requested by architect or engineer).

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

D. Samples: Submit 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.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.
3. 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.
a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
4. 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.
a. Number of Samples: Submit two sets of Samples. Architect will retain one.

E. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

F. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

G. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: 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 Architect.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."

C. 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.

3.2 ARCHITECT'S/ENGINEERS ACTION

A. General: Architect/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect and/or Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect and/or Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action as follows

C. Informational Submittals: Architect/Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:
   1. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

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

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

C. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of 5 previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.
1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.

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

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

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

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

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

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

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

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

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
      d. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services and be responsible for all associated initial costs.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will hire testing company to conduct special tests and inspections per IBC 2015 and as required by authorities having jurisdiction as the responsibility of:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

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

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

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

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

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AGA	American Gas Association
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
APA	APA - The Engineered Wood Association
ARI	Air-Conditioning & Refrigeration Institute

ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	Association of the Wall and Ceiling Industry
AWCMA	American Window Covering Manufacturers Association (Now WCMA)
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI, Inc.
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRRC	Cool Roof Rating Council
CPA	Composite Panel Association

CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet and Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Construction Specifications Institute (The)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FMRC	Factory Mutual Research (Now FM Global)
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization Available from ANSI

ISSFA	International Solid Surface Fabricators Association
LMA	Laminating Materials Association (Now part of CPA)
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NAIMA	North American Insulation Manufacturers Association
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association

NRMCA	National Ready Mixed Concrete Association
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc.

(Now TCNA)

TCNA Tile Council of North America, Inc.

TIA/EIA Telecommunications Industry Association/Electronic Industries Alliance

TMS The Masonry Society

TPI Truss Plate Institute, Inc.

TPI Turfgrass Producers International

TRI Tile Roofing Institute

UL Underwriters Laboratories Inc.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

IAPMO International Association of Plumbing and Mechanical Officials

ICC International Code Council

ICC-ES ICC Evaluation Service, Inc.

UBC Uniform Building Code
(See ICC)

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

EPA Environmental Protection Agency

OSHA Occupational Safety & Health Administration

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG Americans with Disabilities Act (ADA)
Architectural Barriers Act (ABA)
Accessibility Guidelines for Buildings and Facilities
Available from U.S. Access Board

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Section:
1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Water Service from Existing Facility System: Provide connections and extensions of services from existing facility water system as required for construction operations.

C. Electric Power Service from Existing Facility System: Electric power. Provide connections and extensions of electrical services from existing facility lines as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and[ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
   1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction. Connect to Public water service facilities. Meet all requirements of public utility provider.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction

from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   1. Install electric power service underground, unless otherwise indicated.
   2. Connect temporary service to Existing Facility service.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone/Internet Service:
   1. Provide superintendent with cellular telephone for use when away from field office.
   2. Provide computer and internet connection for communication between architect and field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
   2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
   1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
   1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
   2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary parking areas for construction personnel.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
   a. Provide temporary, directional signs for construction personnel and visitors.

H. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 Section "Site Clearing."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Comply with requirements specified in Division 01 Section "Temporary Tree and Plant Protection."

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
   4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
   1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
   2. Keep interior spaces reasonably clean and protected from water damage.
   3. Discard or replace water-damaged and wet material.
   4. Discard, replace or clean stored or installed material that begins to grow mold.
   5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
   1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
   2. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Section:
1. Division 01 Section "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 SUSTITUTION REQUESTS
1. See Submittal Procedures section 012500 for substitution request procedure.

1.4 QUALITY ASSURANCE

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

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered**,** unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered**,** unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with

requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Coordination of Owner-installed products.
   6. Progress cleaning.
   7. Starting and adjusting.
   8. Protection of installed construction.
   9. Correction of the Work.

B. Related Sections:
   1. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
   2. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

C. Certified Surveys: Existing conditions survey to be provide to General Contractor by owner.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
   3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in

reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.
   1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section "Sustainable Design Requirements."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before

fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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

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

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

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and masonry cutting: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F .
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

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

A. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Recycling non-hazardous demolition and construction waste.
   2. Disposing of non-hazardous demolition and construction waste.

B. See Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

C. See Division 4 Section "Unit Masonry Assemblies" for disposal requirements for masonry waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. Recycle Requirements: Owner's goal is to salvage and recycle as much non-hazardous construction waste as possible including the following materials:
   1. Cardboard packaging
   2. Concrete
   3. Concrete masonry units
   4. Land clearing debris (vegetation, stumpage) – NOTE: soil is not included
   5. Metals from banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   6. Clean dimensional wood
   7. Field office waste: office paper, aluminum cans, glass, plastic, and office cardboard
   8. Insulation
   9. Plastic packaging
   10. Plywood, OSB, and particle board

1.4 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Procedures: Separate recyclable waste from other materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   4. Store components off the ground and protect from weather.
   5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

1.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   2. Polystyrene Packaging: Separate and bag materials.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.

C. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

D. Gypsum Board: Stack large clean pieces on wood pallets and store in dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

1.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Burning: Burning of waste materials is permitted only at designated areas on Owner’s property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Transport waste materials and dispose of at designated spoil areas on Owner's property.

E. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Sections:
   1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   3. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   4. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   11. Advise Owner of changeover in heat and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.
   14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for final completion.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
   2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report and warranty.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction
   1. Organize list of spaces in sequential order.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Submit list of incomplete items in the following format:
      a. PDF electronic file.
      b. Paper copies

1.5 WARRANTIES

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

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING.

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
r. Leave Project clean and ready for occupancy.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation manuals for systems, subsystems, and equipment.
2. Systems and equipment maintenance manuals.

B. Related Sections:
1. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:
1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Agent.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. Identify each binder on front and spine, with printed title "OPERATION MANUAL", indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
   2. Performance and design criteria if Contractor is delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number. Use designations for products indicated on Contract Documents.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   6. Normal shutdown instructions.
   7. Seasonal and weekend operating instructions.
   8. Required sequences for electric or electronic systems.
   9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.3 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of operation and maintenance manuals.

E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Sections:
   1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   2. Divisions 02 through 49 Sections for specific requirements for project record documents of the Work in those Sections.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set(s) of marked-up record prints.
   2. Number of Copies: Submit copies of record Drawings as follows:
      a. Initial Submittal: Submit one paper copy of marked-up record prints Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal: Submit one paper copy and CD with digital pdfs of marked-up record prints. Print each Drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and CD with digital pdfs of marked-up Project's Specifications, including addenda and contract modifications.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Record data as soon as possible after obtaining it.
      c. Record and check the markup before enclosing concealed installations.
   2. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
   3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

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

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
   4. Note related Change Orders[and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy and scanned PDF electronic file(s) of marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as paper copy and scanned PDF electronic file(s) of marked up paper copy of Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as paper copy and scanned PDF electronic file(s) of marked up miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 RELATED SECTIONS

A. Division 312000 Earthwork.

1.3 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture.

C. Shop Drawings: For steel reinforcement.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with minimum of five years experience

B. The concrete supplier shall have a minimum of five years experience in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
3. ACI 318 – “Building Code Requirements for Reinforced Concrete”.
4. Concrete Reinforcing Steel Institute (CRSI), “Manual of Standard Practice”.

D. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers. The concrete contractor shall have a minimum of five years experience with installation of concrete similar in material, design and

extent to that indicated for this Project and whose work has resulted in construction with a record of successful –service performance.

E. Any testing laboratory retained to run tests required by this specification shall meet the basic requirements of ASTM E 329.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

A. Refer to the drawings for classes and strengths of concrete required.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I or II. All footing and foundation work should be type II. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or Class F.

C. Normal-Weight Aggregates: ASTM C 33, graded, 3/4-inch nominal maximum coarse-aggregate size.

1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M and potable.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 RELATED MATERIALS

A. Plastic Vapor Retarder: Refer to section 073100.

B. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

C. Waterstops: Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints. Provide flat, dumbbell type or centerbulb type.
1. ADCOR ES waterstops: W.R. Grace & Co.

D. Fabricate steel reinforcement: according to CRSI's "Manual of Standard Practice."

E. Anchor Rods: All anchor rods shall conform to the ASTM designation and shall be of the yield strength as specified below as appropriate for the types and at the locations as specified on the drawings:
1. ASTM F 1554, Grade 55 (1/4 inch to 4 inches in diameter). (Also comply with Supplementary Requirement S1 of ASTM F 1554)
2. Anchor rods used with ASTM A 588 baseplates shall be threaded round stock conforming to ASTM A 588, grade 50.
3. Anchor rods used with galvanized baseplates shall be galvanized.
4. Nuts: All nuts with anchor rods shall be heavy hex head conforming to ASTM A 563.
5. Washers: Unless noted otherwise on the drawings, washer size and thickness for all anchor rods shall conform to Table 14-2 of AISC “Steel Construction Manual” with holes 1/16” greater than the anchor rod diameter. Washers shall conform to ASTM A 36 steel.

F. NON-SHRINK GROUT

1. Type: Grout for base plates, bearing plates and grouting under precast or tilt-up wall panels shall be a non-metallic, shrinkage resistant, premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents and fluidity improving compounds.
2. Specifications: Non-shrink grout shall conform to ASTM C 1107.
3. Compressive Strength: Provide the minimum strength as shown below as determined by grout cube tests at 28 days: 6,000 PSI for supporting concrete 3000 psi and less. 8,000 PSI for supporting concrete greater than 3000 psi and less than or equal to 4000 psi.
4. Unless noted otherwise on the drawings, grout strength on supporting concrete greater than 4000 psi shall be 8000 psi.

G. CONTRUCTION JOINT FILLER
1. Contraction and Construction Joint (including saw joints) -Filler Material for Slabs-on-Grade: In all joints provide a 2 component semi-rigid, 100% solids epoxy joint filler having a minimum shore A hardness of 80 when tested in accordance with ASTM D 2240

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd.when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

E. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Use fly ash as needed to reduce the total amount of portland cement, which would otherwise be used, by not more than 20 percent.

C. Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

3. Slump Limit: 4 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size, for all concrete except interior slabs.
5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

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

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Do not chamfer exterior corners and edges of permanently exposed concrete unless noted otherwise.

3.2 EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto unless directed otherwise by these specifications. Install reglets to receive top edge of foundation sheet waterproofing where specified by the Architect, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles and other conditions.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

C. Do not install sleeves in concrete slabs, pier caps, footings or walls except where shown on the structural drawings or approved by the Architect and Engineer.

D. Securely fasten embedded plates, angles, anchor rods and other items to be built into the concrete to the formwork or hold in place with templates. Insertion of these items into concrete after casting is prohibited.

E. Installation of Adhesive Anchors using Injectable Epoxy or Adhesive:. After drilling the hole to the diameter and depth recommended by the manufacturer, clean the hole with a wire or nylon brush. Blow the dust out of the hole using compressed air with a nozzle that reaches to the bottom of the hole. When using adhesive from a new pack, the adhesive that is discharged from the mixing nozzle should be a uniform gray color before any adhesive is installed in the hole. Fill the hole with adhesive starting from the very bottom of the hole until the hole is about 2/3 full. Do not leave an air pocket at the bottom of the hole. Insert the anchor rod or dowel by slowly twisting it into the hole.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth the depth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces. Do not use form joint in areas subject to vehicle traffic.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.5 CONCRETE PLACEMENT

A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used. Before placing concrete, verify that installation of vapor barrier, formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Concrete shall not be placed when the outside air temperature is 40°F or less unless cold weather concreting practices are followed per engineers approved methods. Design mix shall be formulated for cold weather placement and approved by engineer.

C. Follow hot weather concreting practices when required to limit the concrete temperature at the truck discharge point to the stated maximum acceptable temperature. Design mix shall be formulated for hot weather placement and approved by engineer.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

E. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

F. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use internal vibrators of the largest size and power that can properly be used in the work as described in the table entitled “Range of characteristics, performance, and applications of internal vibrators” found in ACI 301.

G. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix

H. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs. Do not place concrete over columns and walls until concrete in columns and walls is no longer plastic and has been in place at least one hour.

I. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners of forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.

J. Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedges, bull floats or darbies to smooth surface free of humps or hollows before excess moisture or bleedwater appears on the surface. Do not disturb slab surfaces prior to beginning finishing operations.

K. Maintain reinforcing in proper position during concrete placement operations. Placing Concrete by Pump: If concrete is placed by using a pump, the grout used for pump priming must not become a part of the completed structure unless an engineered grout design mix and grout location are approved in advance by the Engineer.

L. Cold-Weather Placement: Comply with ACI 306.1.

M. Hot-Weather Placement: Comply with ACI 301.

N. SLUMP LIMIT

1. The slump, as measured in the field where concrete cylinders are taken, shall be within plus or minus 1 inch of the design slump noted on the Mix Design Submittal Form. Self-consolidating concrete shall have a slump/flow of plus or minus 2 inches of the design slump noted on the Mix Design Submittal Form. Water may be added to the concrete in the field only to the extent that the prescribed water/cementitious ratio noted in the Mix Design Submittal Form is not exceeded.

3.6 FINISHING FORMED SURFACES

A. Rough Form Finish: Provide rough form finish for formed concrete surfaces not otherwise scheduled on the drawings to receive a smooth-form finish. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth Form Finish: Provide smooth form finish for formed concrete surfaces as scheduled on the drawings, which may include those exposed-to-view, or that are to be covered with a coating or covering material applied directly to concrete such as waterproofing, dampproofing, painting, veneer plaster or other similar system, or to a surface that is to receive a smooth rubbed finish or grout cleaned finish. This is an as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections exceeding 1/8 inch in height removed and smoothed.

1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled or specified concrete surfaces, which have received smooth-form finish treatment, not later than one day after form removal. Moisten concrete surfaces and rub with carborundum

brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25. Minimum values F(F) 24 and F(L) 17.
2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete sidewalks, pads, platforms, steps, and ramps, and elsewhere as indicated.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-

weather protection during curing. Coordinate with architectural finish schedule for areas to receive staining. No cure and seal shall occur on concrete slabs to receive staining.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing and Sealing Compound: Apply uniformly to floors and slabs in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period. Verify with flooring subcontractor all that proposed floor covering/adhesives are compatible with cure and seal product.

3.9 CONCRETE SURFACE REPAIRS

A. Defective Concrete:
1. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately undertake the approved repair method.
2. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair and time to affect the repair.
3. Repair method(s), at the sole discretion of the Architect/Engineer or Owner's Representative, may include grinding (floor stoning), planing, retopping with self leveling underlayment compound or repair topping, or any combination of the above.
4. The Architect/Engineer or Owner's Representative maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Architect/Engineer or Owner's Representative, the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
5. The judgment of the Architect/Engineer or Owner's Representative on the appropriateness of a repair method and its ability to achieve the desired end product shall be final

6. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately commence to remove and replace the defective work.
7. All replacement work as a result of defective workmanship shall be performed at no additional cost to the Owner

B. CONCRETE FINISH MEASUREMENT AND TOLERANCES

C. Testing Procedure: ASTM E 1155

D. Tolerance on Floor Elevations: Construction tolerance on absolute floor elevation from the specified elevation as shown on the drawings shall be as specified below, taken from ACI 117:
1. Slab-on-Grade Construction -± 3/4".
2. Top surfaces of formed slabs measured prior to removal of supporting shores ± 3/4".
3. Top surfaces of all other slabs -± 3/4".

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: General Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Testing Services: Tests shall be performed according to ACI 301.

END OF SECTION 033000

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior and Exterior concrete masonry units
2. Exterior architectural concrete split faced masonry units
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Miscellaneous masonry accessories.

1.2 RELATED SECTION

A. Thermal Insulation

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: General Contractor will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
5. Prism Test: For each type of construction required, according to ASTM C 1314.

1.4 SUBMITTALS

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

B. Shop Drawings:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:
1. Colored mortar
2. Colored exterior CMU block

D. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

E. Material Certificates: For each type and size of the following:
1. Masonry units.
   a. Include data on material properties.
   b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   a. Grout mixes. Include description of type and proportions of ingredients.
   b. Reinforcing bars.
   c. Joint reinforcement.
   d. Anchors, ties, and metal accessories.

F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602, Quality Assurance to be equal to Level B

B. Sample Panels: Build sample “mock up” panel on site with selected brick material including precast band.
   1. Build sample panels approximately 48” high by 48” wide of both CMU block and architectural masonry unit. Mock up to include typical installation of thru-wall flashing, ties, horizontal reinforcing, mortar net, weeps, expansion joint and caulking method. Mock up shall include approved colored mortar colors.

C. Sample panel construction will be reviewed and approved by owner and architect for quality to be maintained during the construction of the buildings. Mock up to remain on site until wall construction is completed.

1.6 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

D. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

E. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

F. Cold Weather Protection:
   1. Do not lay masonry when the temperature of outside air is below 40 deg. F, unless means are provided to heat and maintain the temperature of the masonry materials and protect the completed work from freezing, and as may be permitted with the use of non-chloride accelerator. Protection shall consist of heating and maintaining the temperature of the masonry materials to at least 40 deg F, and maintaining an air temperature above 40 deg. F on both sides of the masonry for at least 48 hours as follows:
      a. Cold-Weather Construction: Heat mixing water and sand to produce mortar and grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing. Heat masonry units to 40 deg F (4 deg C) if grouting.
      b. Cold-Weather Protection: Cover masonry with insulating blankets or provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) for 48 hours after construction. Install wind breaks when wind velocity exceeds 15 mi./h (25 km/h).
   2. Do not lay masonry units which are wet or frozen. Do not build on frozen subgrade or setting beds.
   3. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
   4. Remove and replace masonry damaged by freezing conditions.
   5. Do not use additives or accelerators with calcium chloride. Other accelerators may be used but only with approval of Architect.

G. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

H. Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and above

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. CMU

1. Unit size: Thickness as shown on plans with nominal face dimensions of 8 x16" ASTM C 90-09
2. Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 minimum psi
3. Density Classification:
   a. Lightweight units less than 105 lbs/cubic foot. Acceptable for all walls not directly exposed to exterior.
   b. Normal weight units greater than 125 lbs/cubic foot. Acceptable for all wall exposed to exterior or for use below grade. All block exposed to exterior shall contain integral water repellant admix.

C. Approved Manufacturers
1. Acme Brick Company
2. Midwest Block and Brick.
3. Joplin Building Material Company

D. Architectural Masonry Units:
1. Shall be selected from approved manufactures and comply with ASTM C90-09. Minimum compressive strenght 2800 psi.
2. Size: As indicated on drawings.
3. Color: To be selected from standard colors: Including white color range.
4. All block used for exterior applications shall contain water repellant admix to improve unit/wall performance.
5. Water Repellant Sealer: See painting specification.

2.3 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I. Provide natural color or white cement as required to produce mortar color to match surrounding units.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

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

    a. Capital Materials Corporation; Flamingo Color Masonry Cement.
    b. Cemex S.A.B. de C.V.; Brikset Type N, Citadel Type S, Dixie Type S, Kosmortar Type N.
    c. Holcim (US) Inc.; Mortamix Masonry Cement, Rainbow Mortamix Custom Buff Masonry Cement, White Mortamix Masonry Cement.
    d. Lafarge North America Inc.; Magnolia Masonry Cement, Lafarge Masonry Cement, Trinity White Masonry Cement.
    e. Lehigh Cement Company; Lehigh Masonry Cement, Lehigh White Masonry Cement.
    f. National Cement Company, Inc.; Coosa Masonry Cement.

E. Mortar Cement: ASTM C 1329.

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

    a. Lafarge North America Inc.; Lafarge Mortar Cement or [Magnolia Superbond Mortar Cement.

        1) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

F. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

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

    a. Euclid Chemical Company (The); Accelguard 80.
    b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
    c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 420 (Grade 60).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-inch.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- (1.52-mm-) thick, steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.
3. Corrugated Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.060-inch- (1.52-mm-) thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch (25 mm) of masonry face.

D. Partition Top anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

F. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.7 EMBEDDED FLASHING MATERIALS

A. Flashing:
1. Flashing to be equal to Dur O Wal DA1501 with stainless steel termination bar DA1510. See section below for locations and installation instructions.
2. Provide stainless steel drip equal to Dur O Wall DA 1525 continuous at face of flashing.
3. PVC flashing is not allowed.

B. Weeps for multi-wythe walls:
1. Provide Dur O Wall cell vents DA 1006

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
      b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
      c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
      d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, accelerators, retarders, water-repellent agents or other admixtures unless otherwise indicated.

   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by strength to ensure accurate properties, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.

   1. For masonry below grade or in contact with earth, use Type M or Type S. Minimum Mortar strength: Type M 2500 psi, Type S 1800 psi.
   2. For mortar parge coats, use Type M or Type S.
   3. For exterior, above-grade, load-bearing walls and parapet walls, use Type S.
   4. For interior non-load-bearing partitions and exterior 4” veneers, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3000 psi (20.6 MPa)].
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch .
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch .
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet , or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet , 1/4 inch in 20 feet , or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet , 3/8 inch in 20 feet , or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet , 1/4 inch in 20 feet , or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch , with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.2 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in stack bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.4 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.5 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

3.6 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 4 feet for un-inspected walls. Grout pours over 4 feet must be inspected and comply with requirements of ACI 530.1/ASCE 6 TMS 602.

3.7 FIELD QUALITY CONTROL

A. Testing and Inspecting: General Contractor will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense. Provide written report to Architect and Engineer.

B. Inspections: Provide Level 1 special inspections according to the International Building Code and Level B Quality Assurance per TMS 402-11/ACI 530-11/ASCE 5-11..

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 2,000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.8 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch .

B. Use a steel-trowel finish to produce a smooth, flat, dense surface. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.9 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows.
   1. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
      a. Acceptable product:
         1) Eaco Chem: NMD 80
         2) Prosoco: Safety Clean
      b. Muratic acid ma not be used to clean masonry.
   2. Seal architectural masonry per painting specifications. Architect must approved final cleaning of architectural block prior to sealing.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

3.11 MASONRY WASTE DISPOSAL

A. All masonry waste shall be removed from site.

END OF SECTION 042200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural steel and grout.

B. Related Sections:

1. Division 05 Section "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using details indicated.
2. Use ASD; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

1.4 SUBMITTALS

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

B. Shop Drawings:

1. Show fabrication of structural-steel components.: Submit for review and approval shop drawings showing complete details and schedules for fabrication and assembly of structural steel members. The licensed professional engineer responsible for the design of any of the connections shown on the shop drawings shall submit a letter that is sealed attesting that the connection design engineer has reviewed the shop drawings and that the connections detailed and shown on the shop drawings conform to the engineer’s design.
2. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each

weld. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify the type of high-strength bolted connection (slip-critical, direct-tension, or bearing connections). Holes, flange cuts, slots and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.

3. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.

C. Qualification Data: For qualified fabricator.

D. Welding certificates.

E. Mill test reports for structural steel, including chemical and physical properties.

F. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: The structural steel fabricator must participate in the AISC Quality Certification Program. Fabricator must have minimum of 5 years experience in the successful fabrication of structural steel similar to this project.

B. Installer Qualifications: A qualified installer that has a minimum of 5 years experience and have experience on similar size projects.

C. Detailer Qualifications: The structural steel detailer shall have not less than 5 years experience in the successful detailing of structural steel similar to this project including experience in selecting or completing structural steel connection details using information found in tables in the AISC “Steel Construction Manual.

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

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360. "Specification for Structural Steel Buildings".
3. RCSC's "Specification for Structural Joints using High-Strength Bolts”.
4. ANSI/AISC 358, "Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications
5. ANSI/AWS D1.1 "Structural Welding Code -Steel.

F. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Do not store materials on structure in a manner that might exceed allowable loads on or cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed by Architect/Engineer.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL

A. Structural Steel: All hot rolled steel plates, shapes, sheet piling, and bars shall be new steel conforming to ASTM A6.

B. Structural steel shall comply with the provisions of the following ASTM Specifications as appropriate for the grades and types, and at the locations as specified on the drawings:

C. W-Shapes: ASTM A 992/A 992M, Grade 50

D. Channels, Angles -Shapes: ASTM A 36/A 36M.

E. Plate and Bar: ASTM A 36/A 36M.

F. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

C. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Finish: Plain.

D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Finish: Plain.

E. Threaded Rods: ASTM A 36/A 36M.

1. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.

2.3 PRIMER

A. Primer: Fabricator to shop prime with standard primer. Primer to be non-asphaltic rust inhibitor, lead and chromate free.

2.4 GROUT

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

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches .
2. Surfaces to be field welded.
3. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: General Contractor will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: General Contractor will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Rigid Insulation
2. Metal building roof insulation

1.2 SUBMITTALS

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

B. Product test/evaluation reports.

PART 2 - PRODUCTS

2.1 RIGID INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Provide Extruded-Polystyrene board equal to STYROFOAM CAVITYMATE as manufactured by DOW Chemical Company.
2. Thickness: 1.5”
3. Fasteners: Per manufacturers requirements
4. Installation: Provide insulation at locations below vehicle lift in Fleet Service building per lift manufacturers guidelines. Install per manufacturers written installation instructions.

2.2 Vinyl Faced Metal Building Insulation (for Fleet Service Building)
1. Vinyl Faced Insulation: Insulation shall be equal to Owens-Corning Certified R Metal Building Insulation as manufactured by Owens-Corning, One Owens Corning Parkway, Toledo, OH 43659. Insulation at metal roof and wall panels shall be laminated with a vapor retarder listed below. Insulation shall be installed in strict accordance with manufacturer’s recommendations.
2. Roof Insulation: Beneath standing seam metal roof on Fleet Service Building, install 6.3” R-19 vinyl faced insulation, draping over the top of the z-purlins at each z-purlin location, with thermal blocks over each purlin. Insulation shall be draped sufficiently to allow 6” unfaced batt to be snugly placed between the purlins and the metal roof panel. (Do not leave airspace). WMP-10 .0015” white metalized polypropylene film, tri directional scrim reinforcing, and 14# Kraft white paper backing as manufactured by Lamtec Corporation, Bartley-Chester Road, P.O. Box 37, Flanders, New Jersey 07836-0037, Phone: 1-800-852-6832.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thickness, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF RIGID INSULATION

A. Mechanically fasten board to masonry wall with purposed-made plastic friction fit fasteners or use adhesive equal to CGSB 71-BP-24M, Type 1.

B. Install insulation boards over air/vapor barrier membrane starting at the top of footing and extending vertically to top of wall per section details.

C. Place boards in a method to maximize contact with bedding, staggering end joints. Butt edges and ends tight to adjacent bards and to protrusions. Fit insulation board tight around masonry brick ties.

D. If adhesive is used for attachment provide a 6 mm bead of adhesive in a grid pattern to prevent potential air movement behind board. Apply adhesive fully around protrusions.

E. If plastic friction fit fasteners are used place fasteners securely against board to hold boards firmly in place.

F. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

G. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

END OF SECTION 072100

SECTION 073100 – UNDER SLAB VAPOR BARRIER

PART 1 - GENERAL

1.1 SUMMARY

A. Included in this Section
   1. vapor barrier
   2. seam tape
   3. mastic
   4. pipe boots for installation under concrete slabs.

B. Related Sections
   1. Section 033000 Cast-in-Place Concrete

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM
   1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
   2. ASTM E 154-99 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
   3. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials
   4. ASTM F 1249-06 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
   5. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

1.3 SUBMITTALS

A. Quality Control / Assurance
   1. Manufacturer’s samples, literature
   2. Manufacturer’s installation instructions for placement, seaming and pipe boot installation

PART 2 - PRODUCTS

2.1 MATERIALS

A. Vapor Barrier product:
   1. Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC, (877) 464-7834

B. Vapor Barrier must have all of the following qualities:
   1. Must meet ASTM E 1745 Class A
   2. Vapor Barrier products: Permeance of less than 0.01 Perms per ASTM F 1249
   3. ASTM E 1745 Class A .

C. Approved Manufacturers meeting the requirements of this product specification.
   1. Barrier-Bac-Inteplast Group
   2. Insulation Solutions, Inc.
   3. Raven Industries
   4. W.R. Meadows Inc.

D. ACCESSORIES
   1. Seam Tape:
      a. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96
      b. Stego Tape by Stego Industries LLC, (877) 464-7834
   2. Vapor Proofing Mastic:
      a. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96
      b. Stego Mastic by Stego Industries LLC, (877) 46407834
   3. Pipe Boots
      a. Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

E. Approved Manufacturers
   1. W.R. Meadows Inc.
   2. Insulation Solutions, Inc.
   3. Raven Industries

PART 3 - EXECUTION

3.1 PREPARATION

A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
   1. Level and tamp or roll aggregate, sand or granular base.

3.2 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643-98 (2005).
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete pour.
   2. Lap vapor barrier over footings and/or seal to foundation walls.
   3. Overlap joints 6 inches and seal with manufacturer's tape.
   4. Seal all penetrations (including pipes) per manufacturer's instructions.
   5. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.

3.3 FINAL

A. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION 073100

SECTION 074114 – ARCHITECTURAL METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Standing-seam metal roof panels

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide metal roof panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies

B. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated:
   1. Wind-Loads:
      a. Wind Uplift Testing: Certify capacity of metal panels by actual testing of proposed assembly per ASTM E 1592.
      b. Refer to structural drawings.
   2. Snow Loads: Refer to structural drawings.
   3. Deflection Limits: Refer to structural drawings.

C. Air Infiltration, ASTM E 1680: Maximum 0.25 cfm/sq. ft. (1.27 L/s per sq. m) at static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

D. Water Penetration Static Pressure, ASTM E 1646: No uncontrolled water penetration at a static pressure of 12 lbf/sq. ft. (575 Pa).

E. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other

1.3 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For metal roof panel assembly indicated to comply with performance requirements and design criteria.

E. Coordination Drawings: Roof plans, drawn to scale, based on input from installers of the items involved.

F. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements.

G. Product test reports.

H. Field quality-control reports.

I. Maintenance data.

J. Warranties: Samples of special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Fire-Resistance Ratings: Where indicated, provide metal roof panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Combustion Characteristics: ASTM E 136.

C. Preinstallation Conference: Conduct conference at project site.

1.5 WARRANTY

A. Single source Weather Tightness Warranty: Provide manufacturers 10 year “no dollar limit” weather tightness warranty from the date of substantial completion. The roofing manufacture warrants to the building owner, to furnish roof panels, flashing, and related items used to fasten the roof panels and flashing including all penetration accessories, will not allow intrusion of water from the exterior of the roofing manufacturers roof system into the building envelop when exposed to ordinary weather conditions and ordinary wear and tear. The date of substantial completion will be the date certified by the architect as date of substantial completion of the building project.

B. Exterior Material and Finish Warranty: Provide manufacturers 25 year finish warranty.

C. Roofing manufacturer shall provide all necessary site inspections during construction to ensure full manufacturers warranty.

PART 2 - PRODUCTS

2.1 ROOF PANEL MATERIALS

A. Mechanically-seamed, Concealed Fastener, Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with vertical ribs at panel edges, installed by lapping and mechanically interlocking edges of adjacent panels, and attaching panels to supports using concealed clips and fasteners in a weathertight installation.

B. Basis of Design: MBCI, BattenLok HS
1. Panel Type: Standing Seam
2. Panel gage: 24 gage
3. Base metal: Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50, Coating Class AZ50 prepainted by the coil-coating process per ASTM A 755/A 755M
4. Standard Panel Finish: Smooth with striations
5. Substrate : Loadmaster roof deck insulation assembly system on Administration Building and Metal Building Purlins on

6. Panel width: 16”
7. Seam height: 2”
8. Joint type: Mechanically seamed

C. Finish:
1. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. MBCI Signature 300, a premium fluoropolymer low gloss coating produced with KYNAR 500 or HYLAR 5000 resin.
3. Color: To be selected from manufacturers standard colors. Manufacturers bidding project must have equal color range to MBCI’s standard colors.

2.2 METAL ROOF PANEL ACCESSORIES

A. General: Provide complete metal roof panel assembly incorporating trim, copings, fasciae, gutters and downspouts, and miscellaneous flashings, in profiles as indicated. Provide required fasteners, closure strips, thermal spacers, splice plates, support plates, and sealants as indicated in manufacturer's written instructions.

B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.

C. Panel Clips: Provide panel clip of type specified, at spacing indicated on approved shop drawings.

1. Two-piece Floating: ASTM C 645, with ASTM A 653/A 653M, G90 (Z180) hot-dip galvanized zinc coating, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.

D. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating.
1. Provide fasteners with a factory applied coating in a color to match metal roof system application
2. Locate and space all exposed fasteners in a true vertical and horizontal alignment. Use proper torque setting to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.

E. Panel Sealants: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows: Joint Sealant: ASTM C 920; as recommended in writing by metal roof panel manufacturer.

1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.
2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.
3. Concealed Joint Sealant: Non-curing butyl, AAMA 809.2
4. All tube sealant to be one part elastomeric polyurethane sealant approved by the metal roof system manufacturer

F. Approved Equals: Conforming to the requirements specified in this specifications section the following manufactures are approved.
1. Firestone UC-6
2. PAC-CLAD Peterson Aluminum: Tight-Loc
3. Varco Pruden Buildings- SLR-II

2.3 INSULATION

A. See section 072100 for insulation and condensation barrier (when required).

2.4 ACCESSORIES

A. Provide all components required per the metal roof system manufacturer’s approved shop drawings for a complete metal roof system to include panels, panel clips, trim/flashing, fascias, ridge, closures, sealants, filler and any other required item.

B. All outside closures will be fabricated from same sheet steel, gage, finish and color as roof panel.

2.5 FABRICATION

A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated. Color of flashing to match roof panel color.

PART 3 - EXECUTION

3.1 PREPARATION

A. Roof insulation deck system and underlayment shall be installed and approved prior to installation of metal roof panels.

3.2 METAL ROOF PANEL INSTALLATION

A. Mechanically-Seamed, Standing Seam Metal Roof Panels: Install weathertight metal panel system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings. Install metal roof panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor panels and other components securely in place. Provide for thermal and structural movement.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
   1. Install metal roof so that it is weathertight, without waves, warps, bukles, fastening stresses or distortion, allowing for expansion and contraction.
   2. Install metal roof system in accordance with manufacturer’s instructions and shop drawings.
   3. Provide concealed anchors at all panel attachment locations.

4. Install panels plumb, level and straight with seams and ribs parallel, conforming to design as indicated.

3.3 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   2. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   3. Provide elbows at base of downspouts to direct water away from building.

B. Joint Sealers: Install joint sealers where indicated and where required for weathertight performance of metal panel assemblies, in accordance with manufacturer's written instructions.

   1. Prepare joints and apply sealants per requirements of Division 07 Section "Joint Sealants."

3.4 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Touch up minor scratches and abrasions with touch up paint supplied by the metal roof system manufacture.

C. Replace any damaged panel as a result of construction work.

END OF SECTION 074113

SECTION 074213 - INSULATED METAL WALL PANEL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Foamed-insulation-core metal wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
2. Include preparation instructions and recommendations.
3. Include information on installation methods.

B. Shop Drawings:
1. Include elevations, fastening patterns, and sections of each condition.
2. Include material type, metal thickness, paint finish, and manufacturer's installation suggestions.

C. Panel Samples: Submit 1 ft - 0 in by full width sample panel indicating the metal, texture, and finish proposed.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

E. Buy American Certification: Submit documentation certifying that products comply with provisions of the Buy American Act 41 U.S.C 10a-10d.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installed by a contractor with a minimum of five (5) years' experience with this type of construction, and documentation indicating successful completion of contracts for projects of similar size, scope and materials.

B. Manufacturer Qualifications: Manufacturer's production and quality processes are inspected on a quarterly basis by third party quality control auditing programs through Factory Mutual, Underwriter Laboratories, and Intertek Testing Services. Quality control manuals for each accreditation agency are in place detailing the production and quality processes and methods used in the manufacturing of product.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components, or other damage.

B. Deliver, unload, store, and erect metal panels and accessory items in a manner to prevent bending, warping, twisting, and surface damage.

C. Store panels in accordance with manufacturer's written instructions.

D. Shield foam-insulated metal wall panels from direct sunlight until installation.

E. Store products off the ground, with panels sloped for drainage and covered to protect factory finishes from damage. Stack bundles no more than two high.

1.7 WARRANTY

A. Warranty: Manufacturer's written limited warranty providing panels to be free from defects in materials and workmanship, excluding coil coatings (paint finishes) that are covered under separate warranty.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period:
      a. 40 year limited warranty on the exterior paint finish for adhesion to the metal substrate
      b. 30 year limited warranty on the exterior paint finish for chalk and fade.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 72:
   1. Wind Loads: Verified using a 20 psf (96 kPa) simulated wind load.
   2. Deflection Limits: For wind loads, no greater than 1/180 for exterior wall panels and 1/120 for partition and liner walls,.
   3. Large Missile Inpact Test: Conducted in accordance with ASTM E 1886 and ASTM E 1996.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m), Air infiltration shall not exceed 0.01 cfm/sq. ft (0.05 L/s per sq. m) at 6.24 psf (.30 kPa), and 0.04 cfm/ sq. ft (0.2 L/s per sq. m) of wall area] when tested according to ASTM E 283 at a static pressure of 12 psf (.576 kPa).

D. Static Water Penetration: There shall be no uncontrolled water penetration through the panel joints at a static pressure of 20 psf (.96 kPa) when tested in accordance with ASTM E 331.

E. Dynamic Water Penetration: There shall be no uncontrolled water penetration through the panel joints when subjected to a 95 mph (153 kph) slip stream air flow and application of water for a 15 minute period in accordance with AAMA501.1.

F. Condensation Resistance Factor: The minimum condensation resistance factor of the panel shall be 92 when tested in general accordance with AAMA 1503.1.

G. Thermal Performance: Panels shall provide a K-factor of [0.14 btu/sf/hr/deg F] [0.275 btu.sf/hr/deg F] at a 75 deg F (24 deg C) mean temperature when tested in accordance with ASTM C 518.

H. Fire Test Response Characteristics:
   1. Surface Burning Characteristics: The insulated core shall have been tested in accordance with ASTM E 84 for surface burning characteristics. [The core shall have a maximum flame spread of 25 and a smoke developed rating of 450.] [The core shall have a maximum flame spread of 0 and a smoke developed rating of 0.]
   2. Factory Mutual Research Corporation (FMRC) Standard 4880: Panel assembly shall not support a self-propagating fire which reaches any limits of the 50 foot (15.24 m) high corner test structure as evidenced by flaming or material damage of the ceiling of the assembly.
   3. Fire Propagation: The fire assembly shall meet the requirements of the standard for NFPA 285 and NFPA 286. Heat potential shall be determined using NFPA 259 Test Method for Potential Heat of Building Materials.
   4. Canadian Certifications – Flame spread: Evaluation of fire spread over the exterior surface shall be conducted and in compliance with CAN/ULC S138.
   5. IBC Chapter 26: Panel performance under the above test methods, shall meet the requirements of IBC, Chapter on foam plastics.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two roll-formed metal facing sheets chemically bonded to insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
   1. Panel Performance:
      a. Freeze/Heat Cycling: No delamination, surface blistering, or permanent bowing when subjected to cyclic temperature extremes of -20 deg F (-28 deg C) to +180 deg F (+82 deg C) for 21 eight hour cycles.
      b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at 140 deg F (60 deg C) and 100 percent relative humidity according to ASTM D 2126.
      c. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. (958-kPa) positive and negative wind load and with deflection of L/180 for 2 million cycles.
      d. Autoclave: No delamination when exposed to 2-psi (13.8-kPa) pressure at a temperature of 212 deg F (100 deg C) for 2-1/2 hours.
   2. Insulation Core: Polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
      a. Closed-Cell Content: 92 percent when tested according to ASTM D 6226.
      b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D 1622.
      c. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D 1621.
      d. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C 273/C 273M.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Metl-Span LLC product named or comparable product by one of the following:
      a. CENTRIA Architectural Systems.
      b. Firestone Building Products.
      c. MBCI
      d. Morin
   2. Profiled Wall Panels: Metl-Span CF concealed fastener wall panel:
      a. CF-36 Wall Panel, 36 in (914 mm) module width, with SantaFe face with a Light Mesa profiled liner.
         1) Thickness: 2 in (51 mm)
   3. Materials:
      a. Exterior Face: G-90 galvanized steel conforming to ASTM A 653 and/or prefinished AZ50 aluminum-zinc coated steel conforming to ASTM A 792, minimum grade 33 with stucco embossed texture.
         1) Thickness: 22 Ga.
      b. Interior Liner: G-90 galvanized steel conforming to ASTM A 653 and/or AZ50 aluminum-zinc coated steel conforming to ASTM A 792, minimum grade 33, with stucco embossed texture.
         1) Thickness: 26 Ga
      c. Foam Core: Continuously foamed-in-place, zero ODP and zero VOC closed cell polyurethane.
      d. Flashing and Trim:

1) Provide complete insulated metal wall panel assembly incorporating trim and miscellaneous flashings. Provide required fasteners, clips, closures, tapes, and sealants.
2) Flashing and trim shall be brake-formed sheet metal in the same thickness and finish to match panels.

4. Finishes:
   a. Exterior face sheet:
      1) Base Primer: Nominal 0.2 mil (5 microns).
      2) Finish Coat: Nominal 0.7 mil (17.5 microns) full strength 70 percent PVDF Fluoropolymer coating in manufacturer's standard colors.
   b. Interior Sheet:
      1) Primer: Nominal 0.2 mil (5 microns) primer.
      2) Finish Coat: Nominal 0.7 mil (17.5 micron) polyester coating in USDA compliant Igloo White.
5. Side Connections:
   a. CF-36 Insul-Rib™ wall panel shall have offset double tongue and groove joinery with an extended metal shelf allowing fasteners to penetrate both metal faces with clips concealed in the side joint.
6. Sealants:
   a. All sealants shall be field applied to ensure vapor and water tightness.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M,Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
   1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
   2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panelsas required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
   1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
   2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
   3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
   3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
   5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
      a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations

in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:
   1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color: To be selected by architect from manufacturers standard colors. Equal manufacturers bidding project must have colors in range as Metal Span.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all structural steel before beginning installation to insure that all supporting members are straight, level, plumb and satisfactory for panel installation.

B. Intermediate framing member (secondary structural supports) alignment tolerances required, as specified below:
   1. 0 to ¼ inch (0 to 61.25 mm) outward of the actual wall framing plane for members at 10 ft (3.05 m) or greater spacing.
   2. 0 to 1/8 inch (0 to 3.06 mm) outward of the actual wall framing plane for members at 5 ft (1.52 m) to 10 ft (3.05) m spacing.
   3. 0 to 1/16 in (1.5 mm) outward of the actual wall framing plane for members at less than 5 ft (1.52.m) spacing.

C. Do not begin installation until unsatisfactory conditions are corrected.

D. Beginning of installation shall signify the structure and adjacent conditions as being proper and acceptable.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving metal panels.
   2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.

5. Install flashing and trim as metal panel work proceeds. Install flashing and trim true and in proper alignment.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.
1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSULATED METAL WALL PANEL INSTALLATION

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
7. Apply snap-on battens to exposed-fastener, insulated-core metal wall panel seams to conceal fasteners.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.
1. Install clips to supports with self-tapping fasteners.

3.5 FIELD QUALITY CONTROL

A. Panel installer shall inspect and approve each completed wall area and shall be responsible for protection of completed work from damage by other trades.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films before exposure to sunlight.

B. Wipe finished surfaces clean of any filings caused by drilling or cutting to prevent rust staining.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal flashing
   2. Copings and Parapet Cap
   3. Downspouts and Gutters

1.2 SUBMITTALS

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

B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
   1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

C. Samples: For each exposed product and for each finish specified.

D. Maintenance data.

E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

B. Mockups: Build mockups at architects request to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

C. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. Zinc-Coated (Galvanized) Steel Sheet: 24 gage ASTM A 653/A 653M, (G90) coating designation; structural quality.
   2. Exposed Coil-Coated Finish: Kynar 500/Hylar 5000
   1. Color: Color to be selected from manufacturers standard colors. Manufacturers bidding project must have equal color range to Una-Clad's standard colors.

C. APPROVED MANUFACTURES
   1. Firestone/UNA-CLAD
   2. McElroy Metal
   3. MBCI
   4. Metal Era
   5. Peterson Aluminum Corporation
   6. Varco Pruden

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
   2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Solder:
   1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

2.3 REGLETS

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions
   1. Material: Galvanized steel,
   2. Finish: With manufacturer's standard color coating

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Obtain field measurements for accurate fit before shop fabrication.
   2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than (1 inch) deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
   1. Hanger Style: Manufacturer’s standard.
   2. Fabricate from the following materials:
      a. Aluminum-Zinc Alloy-Coated Steel: 24 gage
   3. Size:
      a. Administration building front entry canopies: 3”x4”
      b. Prefabricated entry canopies: 3”x4”

c. Administration upper roofs: 4”x5”
d. Fleet Service and Storage Building: 4”x5”
e. Wash Building: 4”x5”

2.6 WALL SHEET METAL FABRICATIONS

A. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel 24 gage

2.7 COPING

A. Provide 24 gage metal coping as indicated on drawings.
1. Provide 20 ga. galvanized anchor clips continuous at front edge. Fasten with 12-11x1 pancake head self tapper (fastener 13A) at 12” o.c.. Provide 14-10x1 “Type A” self-tapper with washer (fastener #18” at 30” o.c.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Anchor each cleat with approved fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate: wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.

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1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.2 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets and straps spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
2. Size: per drawings.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.

D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in adhesive material compatible with the roofing.

E. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches in direction of water flow.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch) centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric or butyl sealant and clamp flashing to pipes that penetrate roof.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 04 Section "Unit Masonry

C. Opening Flashings in Frame Construction: Install continuous head, sill and similar flashings to extend 4 inches beyond wall openings.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering. Clean and neutralize flux materials. Clean off excess solder and sealants.

B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.

1.2 SUBMITTALS

A. Product Data: For each joint-sealant product indicated..

1.3 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

2.2 SILICONE JOINT SEALANTS

A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.
1. Manufacturers: Provided product by one of the following manufactures, or approved equal.
2. Basis-of-Design Product: Subject to compliance with requirements select from manufacturer below or approved equal
a. Dow Corning Corporation: 786 Mildew Resistant
b. GE Advanced Materials: Silicones: Sanitary SCS1700
c. Tremco Incorporated: Tremsil 200 white
3. Type and Grade: S (single component) and NS (non sag)
4. Class: 25
5. Uses Related to Joint Substrates (per schedule):G, A or as applicable.
6. Use related to exposure: NT (non traffic)

B. Single-Component Neutral Curing Silicone Sealant:
1. Manufacturers: Provided product by one of the following manufactures, or approved equal.

2. Basis-of-Design Product: Subject to compliance with requirements select from manufacturer below or approved equal
   a. Dow Corning Corporation: 790
   b. GE Advanced Materials: SilPruf LM SCS2700
   c. Tremco Incorporated: Spectrem 1 (Basic)
3. Type and Grade: S (single component) and NS (non sag)
4. Class: 100/50
5. Uses Related to Joint Substrates (per schedule): M, G, A or as applicable.
6. Use related to exposure: NT (non traffic)

C. Single Component Pourable Urethane Sealant
1. Manufacturers: Provided product by one of the following manufactures, or approved equal.
2. Basis-of-Design Product: Subject to compliance with requirements select from manufacturer below or approved equal
   a. Bostik, Inc.: Chem-Calk 950
   b. Pecora Corporation: Ureexpan NR-201
   c. Tremco Incorporated: Tremflex S/L, Vulkem 45
3. Type and Grade: S (single component) and NS (non sag)
4. Class: 25
5. Uses Related to Joint Substrates (per schedule): M, G, A or as applicable.
6. Use related to exposure: T (traffic)

2.3 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant-non sag: ASTM C 920.
1. Manufacturers: Provided product by one of the following manufactures, or approved equal.
2. Basis-of-Design Product: Subject to compliance with requirements select from manufacturer below or approved equal
   a. Bostik, Inc.: Chem-Calk 900
   b. Pecora Corporation: Dynatrol I-XL
   c. Tremco Incorporated: Dymonic, Vulkem 921, Vulkem 931
   d. The Euclid Chemical Company: Eucoastic 1
3. Type and Grade: S (single component) and NS (non sag)
4. Class: 100/50
5. Uses Related to Exposure: NT (non traffic)
6. Use related to joint substrates: M, G, A or as applicable.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Manufacturers: Provided product by one of the following manufactures, or approved equal.
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
   a. Bostik, Inc.: Chem-Calk 600
   b. Pecora Corporation: AC 20+
   c. Schnee-Morehead, Inc.: SM 8200
   d. Tremco Incorporated: Tremflex 834
   e. Sonneborn, Division of ChemRex Inc.: Sonalac

2.5 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C closed-cell material with a surface skin, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.

G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints between metal panels
1. Joint Sealant: single component nonsag urethane sealant.

B. Joint-Sealant Application: Exterior vertical joints between different materials
1. Joint Sealant: Single component nonsag urethane sealant

C. Joint-Sealant Application: Exterior perimeter joints between metal wall panels and frames of doors, windows and louvers.
1. Joint Sealant: Single component nonsag urethane sealant

D. Joint-Sealant Application: Exterior control and expansion joints in overhead surfaces.
1. Joint Sealant : Single component nonsag urethane sealant..

E. Joint-Sealant Application: Other exterior joints in vertical and horizontal nontraffic surfaces
1. Joint Sealant: Single component nonsag urethane sealant.

F. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
1. Joint Sealant: Latex sealant.

G. Joint-Sealant Application: Interior perimeter joints of exterior openings.
1. Joint Sealant: Latex sealant.

H. Joint-Sealant Application: Interior ceramic tile expansion, control contraction and isolation joints in horizontal traffic surfaces.\
   1. Joint Sealant: Single component pourable urethane sealant.

I. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors and counters.
   1. Joint Sealant: Single component mildew resistant acid curing silicone sealant.

J. Joint-Sealant Application: Vertical joints on exposed surface of interior unit masonry, walls and partitions.
   1. Joint Sealant: Latex sealant.

K. Joint Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   1. Joint Sealant: Latex sealant.

L. Joint Sealant Application: Interior control, expansion, and isolation joints in horizontal traffic surfaces of flooring and other interior joints in horizontal traffic surfaces.
   1. Joint Sealant: Single component pourable urethane sealant.
   2. See Polished concrete specification section 033500 for joint sealant for all areas to receive polished application.

END OF SECTION 079200

SECTION 083600 – INSULATED SECTIONAL OVERHEAD DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Insulated Sectional Overhead Doors.

B. Electric Operators and Controls.

C. Operating Hardware, tracks, and support.

1.2 RELATED SECTIONS

A. Section 04810 - Unit Masonry Assemblies: Prepared opening in masonry. Execution requirements for placement of anchors in masonry wall construction.

B. Section 05500 - Metal Fabrications: Steel frame and supports.

C. Section 06114 - Wood Blocking and Curbing: Rough wood framing and blocking for door opening.

D. Section 07900 - Joint Sealers: Perimeter sealant and backup materials.

E. Section 16130 - Raceway and Boxes: Empty conduit from control station to door operator.

F. Section 16150 - Wiring Connections: Electrical service to door operator.

1.3 REFERENCES

A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as specified on structural plans in accordance with applicable code.

B. Wiring Connections: Requirements for electrical characteristics.
1. 115 volts, single phase, 60 Hz.

C. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

A. Submit under provisions of Section 012500.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.

B. Protect materials from exposure to moisture until ready for installation.

C. Store materials in a dry, ventilated weathertight location.

1.8 PROJECT CONDITIONS

A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Overhead Door Corporation.

B. Approved Equal Manufacturers
1. Cornell Iron Works
2. Haas Door
3. Coplay

C. Requests for substitutions will be considered in accordance with provisions of Section 012500

2.2 INSULATED SECTIONAL OVERHEAD DOORS

A. Insulated Steel Sectional Overhead Doors: 596 Series Thermacore Insulated Steel Doors by Overhead Door Corporation. Units shall have the following characteristics:
1. Door Assembly: Metal/foam/metal sandwich panel construction, with PVC thermal break and ship-lap design.
a. Panel Thickness: 2 inches (51 mm).

b. Exterior Surface: 20 gauge, galvanized. Flush, textured. (no wood grain texture finish will be accepted).
c. Interior Surface: 20 gauge galvanized, Flush textured. (no wood grain texture finish will be accepted)
d. End Stiles: 16 gauge with thermal break.
e. Springs:
    1) 50,000 cycles..
f. Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
g. Thermal Values: R-value of 17.40; U-value of 0.057.
h. Air Infiltration: 0.08 cfm at 15 mph; 0.08 cfm at 25 mph.
i. Sound Transmission: Class 26.
j. High-Usage Package: Provide with optional high-usage package.
k. Full Glazed Aluminum Sash Panels:
    1) Acrylic glazing.
    2) Insulated double strength glass. 1/2 inch total (1/8 inch (3 mm) double strength glass interior, air space and 1/8" double strength glass exterior).
    3) Note: door 218M and 302 does not require glazing panels.

B. Doors schedule
1. Door Schedule: See architectural plans and schedule for door sizes and locations. Doors marked 220B, 220C, 220D, 220E, 220F shall meet this specification. Provide door and operator as indicated.

C. Finish and Color: Two coat baked-on polyester:
1. Interior color, white.
2. Exterior color, white.
3. Windload Design: Provide to meet the Design/Performance requirements 20 psf (958 Pa).
4. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
5. Weatherstripping:
    a. Bulb-type strip at bottom section.
    b. Flexible Jamb seals.
    c. Flexible Header seal.
6. Track: 3" High Lift
    a. See building sections for track layout and overhead bracing. Provide all required components for complete installation. Support for tracks shall be designed by manufacture for required door weights. See building sections for mounting requirements.
7. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
    a. Motor to be Overhead Door model RHX 208 volt single phase.
    b. Entrapment Protection: Required for momentary contact, includes radio control operation.
        1) Photoelectric sensors monitored to meet UL 325/2010. Overhead Door "Safe T Beam" model.
    c. Auxiliary output module
        1) Provide auxiliary output module in all operators to allow for integration with monitoring system. See electrical plans for monitor/controller to be provided by others.
    d. Operator Controls:
        1) Push-button operated control stations with open, close, and stop buttons.
        2) Surface mounted boxes. Conduit at exterior locations to be concealed in wall.

3) Provide at interior and exterior side of all doors as indicated on electrical plans for all locations.
4) Exterior buttons to be exterior rated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General contractor and door supplier shall be responsible for verifying final opening dimension prior to ordering any doors and adjust the final door dimension based on final field parameters.

B. General Contractor shall verify all clearances and required framing for complete system attachment and shall provide all required structural steel, secondary framing, etc. for doors, operators and controls as required for complete installation.

C. Do not begin installation until openings have been properly prepared.

D. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

E. Verify electric power is available and of correct characteristics.

F. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.

B. Installation with adjacent work to ensure proper clearances and allow for maintenance.

C. Assembly to wall construction and building framing without distortion or stress.

D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

E. Fit and door assembly including hardware.

F. Installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.4 CLEANING AND ADJUSTING

A. Adjust door assembly to smooth operation and in full contact with weather stripping.

B. Clean doors, frames and glass.

C. Remove temporary labels and visible markings.

3.5 PROTECTION

A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

B. Protect installed products until completion of project.

C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion

END OF SECTION 083600

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:
   1. Swinging doors.
   2. Overhead doors.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Cylinders specified for doors in other sections.

C. Related Sections:
   1. Division 08 Section “Door Hardware Schedule”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. NFPA 80 - Fire Doors and Windows.
   4. NFPA 101 - Life Safety Code.
   5. NFPA 105 - Installation of Smoke Door Assemblies.
   6. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:
   1. ANSI/BHMA Certified Product Standards - A156 Series
   2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
   2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

E. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 5 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
   1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
   a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
   b. Door Closers: Comply with the following maximum opening-force requirements indicated:
      1) Interior Hinged Doors: 5 lb. applied perpendicular to door.
      2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
   c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
3. NFPA 101: Comply with the following for means of egress doors:
   a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
   b. Thresholds: Not more than 1/2 inch high.
4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
   a. Test Pressure: Positive pressure labeling.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors.

Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
1. Ten years for extra heavy duty cylindrical (bored) locks and latches.
2. Five years for exit hardware.
3. Twenty-five years for manual surface door closers.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
   a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
      1) Out-swinging exterior doors.
      2) Out-swinging access controlled doors.
      3) Out-swinging lockable doors.
5. Acceptable Manufacturers:
   a. Bommer Industries (BO).
   b. Hager Companies (HA).
   c. McKinney Products (MK).

2.3 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
   1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with square corners and beveled edges, secured with exposed screws unless otherwise indicated.
   2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
   3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
   4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
      a. Acceptable Manufacturers:
         1) Burns Manufacturing (BU).
         2) Hiawatha, Inc. (HI).
         3) Rockwood Manufacturing (RO).
         4) Trimco (TC).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
   1. Acceptable Manufacturers:
      a. Corbin Russwin Hardware (RU).
      b. Sargent Manufacturing (SA).

C. Cylinders: Original manufacturer cylinders complying with the following:
   1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
   2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
   4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
   5. Keyway: Manufacturer's Standard.

D. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
   1. Grand Master Key System: Cylinders are operated by a change key, a master key, and a grand master key.

E. Key Quantity: Provide the following minimum number of keys:
   1. Top Master Key: One (1)
   2. Change Keys per Cylinder: Two (2)
   3. Master Keys (per Master Key Group): Two (2)
   4. Grand Master Keys (per Grand Master Key Group): Two (2)

F. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

2.5 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
   1. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
   2. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
   3. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy-duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.
      a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
      b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.
   4. Rail Sizing: Provide exit device rails factory sized for proper door width application.
   5. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.
   1. Acceptable Manufacturers:
      a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.

b. Sargent Manufacturing (SA) - 80 Series.
c. Von Duprin (VD) - 35A/98 XP Series.
d. Yale Locks and Hardware (YA) - 7000 Series.

C. Security Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified rim panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be constructed of high grade, heat treated, corrosion resistant nickel steel alloy, and have a full 3/4" throw projection with slide action positive deadlocking.
1. Static Load Force Resistance: Minimum 3000 lbs certified independent tested.
2. Acceptable Manufacturers:
   a. Corbin Russwin Hardware (RU) - ED4000S / ED5000S Series.
   b. Yale Locks and Hardware (YA) - 7150 / 7250 Series.

2.6 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover
2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors
3. Cycle Testing: Provide closers that have surpassed 10 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy-duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
   a. Where closers are indicated to have mechanical dead stop, provide heavy duty arms and brackets with an integral positive stop.
   b. Where closers are indicated to have mechanical hold open, provide heavy-duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
   c. Where closers are indicated to have a cushion-type stop, provide heavy-duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
   d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Acceptable Manufacturers:
   a. Corbin Russwin Hardware (RU) - DC8200 Series.
   b. LCN Closers (LC) - 4040XP Series.
   c. Sargent Manufacturing (SA) - 281 Series.

2.7 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

C. Acceptable Manufacturers:
   1. Pemko Manufacturing (PE).
   2. Reese Enterprises, Inc. (RS).
   3. Zero International (ZE).

2.8 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.9 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
   1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
   2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
   3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
   4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:
1. MK – McKinney
2. RO – Rockwood
3. RU - Corbin Russwin
4. PE - Pemko

Hardware Schedule

Set: 1.0
Doors: 2220B, 220C, 220D, 220E, 220F
Description: Exterior

Notes: All hardware furnished by Overhead Door Supplier.

Set: 2.0
Doors: 220A, 220G
Description: Exterior

1 Continuous Hinge	MCK-25HD	CL	MK
1 Exit Device (rim, exit only)	ED5200S M52	630C	RU
1 Cylinder	1000-118-A02-6-Pin	626	RU
1 Door Pull	BF157 Mtg-Type 12HD	630	RO
1 Closer (spring stop)	DC8210 x A11 x W33 x M54	689	RU
1 Kickplate	K1050 x 4BE x CSK x 10" x 34"	630	RO
1 Door Stop	462	US2C	RO
1 Threshold	2005AT x 36" W		PE
1 Drip Cap	346C x 40" W		PE
1 Weatherstripping	2891AS x 36" x 84" (Head & Jambs)		PE
1 Sweep Strip	345ANB x 36" W		PE
1 Door Position Switch			

Notes: Install weatherstrip before installing Door Closer and Exit Device Strike.

END OF SECTION 087100

SECTION 099123 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems and coatings on the following interior substrates:
   1. Concrete masonry units (CMU).
   2. Steel.
   3. Galvanized metal.
   4. Aluminum (not anodized or otherwise coated).
   5. Spray-textured ceilings.

B. This Section includes surface preparation and the application of paint systems and coatings on the following exterior substrates:
   1. Brick
   2. Steel
   3. Aluminum

1.2 SUBMITTALS

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

B. Samples: For each finish and for each color and texture required.

C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

A. MPI Standards:
   1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
   2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.
   2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
   3. Final approval of color selections will be based on benchmark samples.
      a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
   1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
   The Sherwin-Williams Company or Approved Equal- “Pro Green”
   101 Prospect Avenue NW
   Cleveland, OH 44115
   Tel: (800) 321-8194
   Fax: (216) 566-1392
   www.sherwin-williams.com
   Other acceptable Manufacturers: KWAL, Benjamin Moore, ICI, PPG Pittsburgh Paints
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Substitutions: Requests for substitution will be considered in accordance with provisions of section 012500 product requirements. When submitting requests for substitution, provide complete product data specified above under submittals, for each substitute product.

C. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
   1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
   2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
   3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
   4. Floor Coatings: VOC not more than 100 g/L.
   5. Shellacs, Clear: VOC not more than 730 g/L.
   6. Shellacs, Pigmented: VOC not more than 550 g/L.
   7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
   8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
   9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
   10. Floor Coatings: VOC not more than 100 g/L.
   11. Shellacs, Clear: VOC not more than 730 g/L.
   12. Shellacs, Pigmented: VOC not more than 550 g/L.
   13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
   14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
   15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
   16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

D. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
   1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   2. Restricted Components: Paints and coatings shall not contain any of the following:
      a. Acrolein.
      b. Acrylonitrile.
      c. Antimony.
      d. Benzene.
      e. Butyl benzyl phthalate.
      f. Cadmium.
      g. Di (2-ethylhexyl) phthalate.
      h. Di-n-butyl phthalate.
      i. Di-n-octyl phthalate.
      j. 1,2-dichlorobenzene.
      k. Diethyl phthalate.
      l. Dimethyl phthalate.
      m. Ethylbenzene.
      n. Formaldehyde.
      o. Hexavalent chromium.
      p. Isophorone.
      q. Lead.
      r. Mercury.
      s. Methyl ethyl ketone.
      t. Methyl isobutyl ketone.
      u. Methylene chloride.
      v. Naphthalene.
      w. Toluene (methylbenzene).
      x. 1,1,1-trichloroethane.
      y. Vinyl chloride.

E. Colors**:** As selected by Architect from manufacturer's full range.

2.2 INTERIOR PAINTING and COATING
(2.5 - 3 mils dry per coat)

A. MASONRY CMU'S (all areas)

1. Epoxy Systems

a. Low Luster Finish
1st Coat: S-W Heavy Duty Block Filler
2nd Coat:S-W Pro Industrial- Hi-Bild-waterbased catalyzed epoxy, B71- V110
(2.5 - 3 mils dry per coat)
3rd Coat: S-W Pro Industrial- Hi-Bild-waterbased catalyzed epoxy, B71-V110
(2.5 - 3 mils dry per coat)

B. METAL (Railing Systems, Door and Door frames)
1. Acrylic Systems
a. LOWER ODOR/LOW VOC: Semi-Gloss Finish
1st Coat: S-W Pro Industrial Pro-Cryl® Universal Primer, B66-310 Series (5-10 mils wet, 2-4 mils dry per coat)
2nd Coat: S-W Pro Industrial 0 VOC Acrylic, B66-650 Series
3rd Coat: S-W Pro Industrial 0 VOC Acrylic, B66-650 Series (7 mils wet)

C. METAL (steel deck, angles, joists, beams, ductwork, conduit, water & gas piping, etc.)

1. Dryfall Systems

a. Flat Finish
1st Coat: S-W Pro Industrial Pro-Cryl® Universal Primer, B66-310 Series (5-10 mils wet, 2-4 mils dry per coat)
2nd Coat: S-W Waterborne Acrylic Dry Fall Flat White, B42W1 Series
3rd Coat: S-W Waterborne Acrylic Dry Fall Flat White, B42W1 Series (7-11 mils wet, 3-4.5 mils dry per coat

D. METAL (exposed structural columns)
1. Alkyd System, Gloss Finish
a. 1st Coat: S-W Kem Kromik Universal Metal Primer, B50Z Series
b. 2nd Coat: S-W Industrial Enamel B54 Series
c. 3rd Coat: S-W Industrial Enamel B54 Series (2.5-4 mils wet, 2.2-3.5 mils dry)

E. EXPOSED CONCRETE FLOORS
1. Provide sealer over all exposed concrete floors not covered with floor covering or indicated as polished concrete or hardener/densifer.
2. Sealer to be equal to Infusion Water Based Sealer as supplied by H & C Concrete/Sherwin Williams. 1-800-867-8246 or www.hcconcrete.com.
3. Sealer is to be applied to new concrete surface. Moisture cure or apply clear non-residual curing compound.
4. See finish schedule for locations requiring sealer

2.3 EXTERIOR PAINTING AND COATINGS

A. ARCHITECTURAL SMOOTH FACED BLOCK
1. All exposed surfaces of split faced block shall receive a proper application of Siloxane WB by Sure Klean as manufacturer by Prosoco, Inc., 3741 Greenway Circle, Lawrence, KS 66046; phone (800) 255-4255. The material shall be applied as follows:
a. Painting contractor shall apply two coats of weather seal to all split faced surfaces, including mortar joints and other exposed concrete and masonry surfaces.
b. Both coatings of materials shall be installed in accordance with the manufacturer's recommendations and the quality of material to be used per square foot of area.

B. MISCELLANEOUS METALS (Lintels, bollard, gas piping, etc.)
1. Alkyd System, Gloss Finish
a. 1st Coat: S-W Kem Kromik Universal Metal Primer, B50Z Series
b. 2nd Coat: S-W Industrial Enamel B54 Series
c. 3rd Coat: S-W Industrial Enamel B54 Series

(2.5-4 mils wet, 2.2-3.5 mils dry

C. STEEL HANDRAIL SYSTEMS
1. Alkyd System, Gloss Finish
a. 1st Coat: S-W Kem Kromik Universal Metal Primer, B50Z Series
b. 2nd Coat: S-W Industrial Enamel B54 Series
c. 3rd Coat: S-W Industrial Enamel B54 Series
(2.5-4 mils wet, 2.2-3.5 mils dry)

2.4 MATERIALS

A. Paints and Coatings - General:
1. Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such a procedure is specifically described in manufacturer's product instructions. VOC numbers need to be confirmed by using the products MSDS sheets.

2.5 ACCESSORIES

A. Coating Application Accessories:
1. Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required per manufacturers specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin application of coating until substrates have been properly prepared. Notify Architect of unsatisfactory conditions before proceeding.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Proceed with work only after conditions have been corrected and approved by all parties otherwise application of coatings will be considered and acceptance of surface conditions.

3.2 SURFACE PREPARATION

A. Proper product selection, surface preparation, and application affect coating performance. Coating integrity and service life will be reduced because of improperly prepared surfaces. Selection and implementation of proper surface preparation ensures coating adhesion to the substrate and prolongs the service life of the coating system.

B. Selection of the proper method of surface preparation depends on the substrate, the environment, and the expected service life of the coating system. Economics, surface contamination, and the effect on the substrate will also influence the selection of surface preparation methods.

C. The surface must be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.

D. Remove mildew before painting by washing with a solution of one (1) part liquid household bleach and three (3) parts of warm water. Apply the solution and scrub the mildewed area.

Allow the solution to remain on the surface for 10 minutes; however, do not allow the solution to dry on the surface. Rinse thoroughly with clean water and allow the surface to dry 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.

E. No painting should take place when the interior temperature is below 50°F unless the specified product is designed for the marginal conditions.

F. Methods
1. Aluminum: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.
2. Block: Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners. Concrete and mortar must be cured at least 30 days at 75°F unless the manufactures products are designed for application prior to the 30-day period. The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface. Fill bug holes, air pockets, and other voids with a cement patching compound.
3. Concrete: This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls, and shotcrete surfaces. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.
4. Galvanized Metal: Clean per SSPC-SP1 using detergent and water or a degreasing cleaner to remove greases and oils. Apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP7 is necessary to remove these treatments.
5. Steel: Structural, Plates, etc.: Clean per SSPC-SP1, solvent cleaning. Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation.

3.3 INSTALLATION

A. Apply all coatings and matrials with manufacturer specifications in mind. Mix and thin coatings according to manufacturer’s recommendations.

B. Do not apply to wet or damp surfaces.
1. Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer’s procedures to apply appropriate coatings prior to 30 days.
2. Test new concrete for moisture content.

C. Apply coatings using methods recommended by manufacturer.

D. Uniformly apply coatings without runs, drips, or sags, without brush marks and with the consistent sheen.

E. Apply coatings at spreading rate required to achieve the manufacturer's recommended dry film thickness.

F. Dark colors and deep clear colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Inspection: The coated surface must be inspected and approved by the Architect or Engineer just prior to each coat.

3.4 PROTECTION

A. Protect finished coatings from damage until completion of project.

B. Touch-up damaged coating after substantial completion, following manufacturer's recommendations for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION 099123

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Fire extinguishers for cabinets.

B. Wall mounted fire extinguishers and brackets.

1.2 SUBMITTALS

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

B. Operation and maintenance data.

C. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire extinguisher cabinet indicated.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Product: Provide fire extinguishers as manufactured by following companies.
      a. Amerex Corporation.
      b. Ansul Incorporated; Tyco International Ltd.
      c. Badger Fire Protection; a Kidde company.
      d. Buckeye Fire Equipment Company.
      e. Fire End & Croker Corporation.
      f. J. L. Industries, Inc.; a division of Activar Construction Products Group.

g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
h. Larsen's Manufacturing Company.
i. Moon-American.
j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
k. Potter Roemer LLC.
l. Pyro-Chem; Tyco Safety Products.

B. Typical Fire Extinguishers: Regular Dry-Chemical Type UL-rated 20 lb. Class B nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

C. Brackets: Wall mounted fire extinguishers to have bracket equal to Larsen 577. Mount bracket to allow top extinguisher to be mounted maximum of 48” AFF.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging before installation.

END OF SECTION 104416

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural-steel framing.
   2. Thermal roof insulation.
   3. Accessories.

1.2 SUBMITTALS

A. Product Data: For each type of metal building system component.

B. Shop Drawings: For metal building system components. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation. Details and plans outline basic connection types between metal building components and structural steel components. Beam to Beam and Beam to Column connections shall be sized by metal building professional engineer as standard AISC, Type 2, Bearing connections capable of supporting reactions developed by maximum uniform load capacity on a simple span for beam and beam span given.

E. Welding certificates.

F. Metal Building System Certificates: For each type of metal building system, from manufacturer.
   1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
      a. Name and location of Project.
      b. Order number.
      c. Name of manufacturer.
      d. Name of Contractor.
      e. Building dimensions including width, length, height, and roof slope.
      f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
      g. Governing building code and year of edition.
      h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).

i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
j. Building-Use Category: Indicate category of building use and its effect on load importance factors.

G. Material test reports.

H. Source quality-control reports.

I. Field quality-control reports.

J. Maintenance data.

K. Warranties: Sample of special warranties.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.
1. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.

E. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

F. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY
1. Manufacturer’s standard one year warranty on materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. A&S Building Systems, Inc.; Division of NCI Building Systems, L.P.
2. Alliance Steel

3. American Buildings Company; A Nucor Company
4. Butler Manufacturing Company; a BlueScope Steel company.
5. CBC Steel Buildings; A Nucor Company
6. Ceco Building Systems; Division of NCI Building Systems, L.P.
7. Garco Building Systems; Division of NCI Building Systems, L.P..
8. Mesco Building Solutions; Division of NCI Building Systems, L.P.
9. Metallic Building Company; Division of NCI Building Systems, L.P.
10. Metco Metal Supply.
11. Mid-West Steel Building Company; Division of NCI Building Systems, L.P.
12. Nucor Building Systems A Nucor Company.
13. Olympia Steel Building Systems.
14. Pinnacle Structures, Inc.
15. Star Building Systems; an NCI company.
16. United Structures of America
17. VP Buildings; a BlueScope Steel Company
18. Vulcan Steel Structures, Inc.

2.2 METAL BUILDING SYSTEM PERFORMANCE

A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Metal building systems shall be designed according to procedures in MBMA's "Metal Building Systems Manual."
   1. Design Loads: As indicated on Drawings.
   2. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
      a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
      b. Girts: Horizontal deflection of 1/360 of the span.
      c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
      d. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
      e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
   3. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
      a. Lateral Drift: Maximum of 1/400 of the building height for systems directly supporting masonry or other brittle wall systems.
   4. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.

C. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of

connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, material surfaces.

2.3 STRUCTURAL-STEEL FRAMING

A. Primary Framing: Manufacturer's Rigid Frame (RF Series) solid web framing consisting of tapered or uniform depth rafters rigidly connected to tapered or uniform depth columns. System to be designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; connections; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly.

B. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly.

C. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating.

D. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated or hot-dip galvanized bolts for structural-framing components that are galvanized.

E. Wind Bracing: Portal, torsional, diagonal bracing or diaphragm in accordance with manufacturer's standard design practices; utilizing rods, angles, and other members, with minimum yield strengths as required for design but in most cases, 50 ksi.

F. Primary Frame Flange Bracing: Attached from purlins or girts to the primary framing, minimum yield strength as required for design but in most cases 60 ksi.

G. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

2.4 MISCELLANEOUS FRAMING

A. Base Angles: 2 inch by 3 inch by 0.059 inch (50 mm by 75 mm by 1.5 mm) galvanized steel angles, with minimum yield strength of 55 ksi (380 MPa), anchored to the floor slab or grade beam with power driven fasteners or equivalent at a maximum spacing of 4 feet (1220 mm) on center and not more than 6 inches (150 mm) from the end of any angle member. Anchors are not provided by the metal building manufacturer.

B. Door Headers and Jambs: Zee- or Cee-shaped; depth as required; with minimum yield strength of 60 ksi (410 MPa).

2.5 INSULATION

A. Roof insulation: provide 6”thick R-19 vinyl faced insulation WMP-VR (PSK-LD as manufactured by Lamtec Corporation. Facing: White polypropylene film fiberglass and polyester scrim; reinforced 11# natural kraft, 0.0015 inch (thick plus or minus 10 percent; permeance in compliance with ASTM E 96 1.00 perm (5.17 ng/Ns). Tri-directional fiberglass and facing meeting Flame Spread of 25 or less, Smoke Developed of 50 or less, when tested in accordance with UL 723. #11 natural kraft. as manufactured

B. Wall insulation: 4” thick vinyl faced insulation, WMP-10 (PSK-SD) as manufactured by Lamtec Corporation. Facing: White polypropylene film metallization fiberglass & polyester scrim 14# white craft. 0.0015 inch (thick plus or minus 10 percent; permeance in compliance with ASTM E 96 0.02 perm (1.15 ng/Ns). Tri-directional fiberglass/polyester. Facing meeting Flame spread of 25 or less, Smoke Developed of 50 or less, when tested in accordance with UL 723.

C. Thermal Blocks: High density, 3/4 inch (19 mm) thick expanded polystyrene, for installation over the purlin.

D. See section 072100.

2.6 METAL ROOF PANELS

A. See section 074114 for metal roof panels.

2.7 METAL WALL PANELS

A. See section 074213 for metal wall panels.

2.8 METAL LINER PANELS

A. Use standard liner panels as approved and provided by the metal building supplier.

2.9 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
   1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Flashing and Trim: Formed from 0.022-inch nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.

C. Gutters: 24 gage, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces

as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

D. Downspouts: 24 gage, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.
   .
2. Continuous or Sectional-Ridge Type: Factory-engineered and -fabricated, continuous unit; 24 gage, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels. Fabricated in minimum 10-foot- long sections. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, end caps, splice plates, and reinforcing diaphragms.
   a. Bird Screening: Galvanized steel or aluminum

E. Interior metal liner panels: 26 ga Butlerib® II panels exposed fasteners as furnished by Butler Manufacturing Company and installed in accordance with the manufacturer's instructions.

F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to evaluate field welds and bolt connections as required per International Building Code.

B. Special Inspector: Contractor will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.

1. Special inspections will not be required if fabrication is performed by manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.
   a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

C. Testing: Test and inspect field connections for metal buildings according to the following:

1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
2. Field Welded Connections: In addition to visual inspection, connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
   a. Liquid Penetrant Inspection: ASTM E 165.

b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. Product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

2.11 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.
1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

D. Secondary Framing: Shop fabricate framing components to size and section by roll-forming or break-forming. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

PART 3 - EXECUTION

3.1 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
    a. Joint Type: Snug tightened or pretensioned.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Locate canopy framing as indicated.
4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Steel Joists: Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.
1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Bolt joists to supporting steel framework using carbon-steel bolts unless high-strength structural bolts are required by the manufacturer.
5. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
6. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
   1. Tighten rod and cable bracing to avoid sag.
   2. Locate interior end-bay bracing only where indicated.

J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.2 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
   1. Provide elbows at base of downspouts to direct water away from building.
   2. Tie downspouts to underground drainage system indicated.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

END OF SECTION 133419

SECTION 210010 - GENERAL FIRE SUPPRESSION REQUIRMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 21 of the Specifications and Drawings numbered with prefixes P generally describe these systems, but the scope of the Fire Suppression work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general location and arrangement of the equipment, piping, etc. without showing all the exact details as to elevations, offsets, pipe routing, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

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

1. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
2. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
3. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
4. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.

1.2 QUALITY ASSURANCE

A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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

F. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.

G. Regulatory Requirements: Comply with all standards listed in Section 1.2 and all applicable local requirements.

H. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section, Division 26 and Division 28.

I. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.3 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the submission of Bids, to prepare

the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.

1. NFPA (National Fire Protection Association) 13, “Installation of Sprinkler Systems”, 2013 Edition.
2. NFPA 25, “Inspection, Testing and Maintenance of Water-Based Fire Protection Systems”, 2013 Edition.
3. Underwriters Laboratories, “Fire Protection Equipment Directory”, Latest Edition.

4. International Building Code (IBC), 2015 Edition with local amendments.
5. International Fire Code (IFC), 2015 Edition with local amendments.

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All Fire Suppression work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Fire Suppression work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. Furnish: The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”
4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.

5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant

to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.

6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.

    a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

9. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

D. Other definitions for fire protection systems are listed in NFPA Standards 13.

E. Working Plans, also referred to as Fire Protection Drawings as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the Authority Having Jurisdiction.

1.5 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the

bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.

C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Fire Suppression systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect/Engineer. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

E. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire protection system shall include, but not be limited to:

1. Sprinkler monitoring equipment (water flow switches, valve tampers, etc) shall be provided by the fire sprinkler installer, but wired and connected by Division 26.

F. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and described within the specification sections.

1.6 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

A. Refer to Division 01 and General Conditions for submittal requirements, in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual Sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before Fire Suppression construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined

in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

L. Provide shop drawings prepared in accordance with referenced standards identified as "Working Plans", including hydraulic calculations where applicable. Shop drawings shall be signed and sealed by a Professional Engineer registered in the state in which the project is located where required by local authorities having jurisdiction, or NICET Level III or IV certified technician. Submit copies of the certification for the designer with submittal. Shop drawings consisting of the following shall be furnished at a minimum. Refer to NFPA 13 for additional requirements.

1. Scaled site plan indicating underground piping with sizes and hydrants utilized for flow test in relation to the building.
2. Layout drawings of complete fire sprinkler system indicating relationship to all other trades. This shall include all equipment, piping and a reflected ceiling plan indicating sprinkler locations.
3. Complete details and sections as required to clearly define and clarify the design indicated.
4. Shop drawings shall be to a standard scale and not less than 3/32" = 1'-0".
5. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.

6. Hydraulic calculations shall be based on a water flow test conducted at the site within twelve (12) months of the submittal of plans for approval. The contractor shall be responsible for obtaining the flow test if existing data is not available. Flow test information shall be documented on shop drawings with an accompanying site plan to scale. Contractor shall verify with AHJ any minimum safety factor requirements. Demand shall not be less than 10 percent below the supply at the demand point.

    a. Hydrant testing shall be in accordance with NFPA 13 and 291 requirements.

M. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval. Shop drawings showing deviations from the design without prior approval will not be approved.

N. Provide welders' qualification certificates.

O. Provide Test Reports and Certificates including:

1. "Contractor's Material & Test Certificate for Aboveground Piping"

1.8 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.9 SUBSTITUTIONS

A. Refer to Division 1 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:

1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:

a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
c. Proposed substitution has received necessary approvals of authorities having jurisdiction.

d. Same warranty will be furnished for proposed substitution as for specified Work.
e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:

1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion for the project, furnish to the Architect, for Engineer’s review,and for Owner’s use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Include the following sections with the appropriate information for each section:

1. Typewritten Index.
2. Qualifications. Provide designer and installer qualification.
3. Bill of Materials. Provide complete nomenclature, model number and vendor information for all parts.
4. Operating Instructions. Complete instructions detailing operation and maintenance of all equipment installed.

5. Product Data: Provide product cut-sheets for all equipment utilized and installed.
6. Guarantee. Copy of all guarantees and warranties issued.
7. Testing/Certification: Provide all completed testing and certification forms as required per NFPA 13 and 25.
8. Contact list with minimum three service representative phone numbers.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.11 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 21 specifications.

1.12 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

D. The fire shop drawings and all information contained therein shall be utilized as the basis for the Record Drawings.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in a format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports shall be painted by the Fire Suppression Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Furnish service and maintenance of fire protection system for one year from date of substantial completion.

C. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial

Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

D. The following additional items shall be guaranteed:

1. Piping shall be free from obstructions, holes or breaks of any nature.
2. Proper sloping of pipe to drain in each piping system per NFPA 13.

E. The above guarantees shall include labor (including travel expenses), troubleshooting and material; and repairs or replacements shall be made without additional cost to the Owner.

F. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

G. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed and stating the commencement date and term.

1.17 PROJECT CONDITIONS

A. Conditions Affecting Work In Existing Buildings:

1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the site prior to submitting their bid to determine the nature and extent of work involved.
2. Work in the existing building shall be scheduled with the Owner.
3. Certain demolition work must be performed prior to the remodeling. The Fire Suppression Contractor shall perform the demolition which involves Fire Suppression and Fire Suppression systems, equipment, piping, equipment supports or foundations and materials.
4. Fire Suppression Contractor shall remove articles which are not required for the new work. Unless otherwise indicated, each item removed by the Fire Suppression Contractor during this demolition shall be removed by the Fire Suppression Contractor from the premises and disposed of in accordance with applicable federal, state and local regulations.
5. Fire Suppression Contractor shall relocate and reconnect Fire Suppression equipment that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Fire Suppression equipment or materials are removed, the Fire Suppression Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
6. General Contractor shall install finish material.
7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.

8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
9. Locate, identify, and protect Fire Suppression 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, install temporary services for affected areas.

B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

A. Electrical Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Fire Suppression Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Fire Suppression Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.

B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections.

C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

D. All fire protection equipment shall be UL listed for its intended use and in conformance with the applicable NFPA codes.

E. System Pressures: All system components shall be listed for the actual designed system pressures.

1. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install, and test all new equipment identified in this contract and revise existing equipment as noted.

B. Installation shall be in accordance with NFPA requirements and the Contractor shall have employed or enlist the design services of at least one minimum NICET Level II certified technician.

C. Installer: Company specializing in the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire sprinkler submittal proof of factory training for each installer.

D. The Contractor shall provide all required equipment, sprinklers and piping for a complete and operational fire protection system. All components shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.

E. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

3.2 PERMITS

A. Secure and pay for permits required in connection with the installation of the Fire Suppression Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.3 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Section.

B. Report test results promptly and in writing.

3.4 EXISTING UTILITIES

A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.

B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.

C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.

D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.

E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.5 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned Fire Suppression 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 Fire Suppression 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. Fire Suppression Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings, specialties, equipment and controls.

    a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping allowed to remain.
    b. Perform cutting and patching required for demolition in accordance with Division 1, General Conditions and "Cutting and Patching" portion of this Section in Division 21.

3.6 CUTTING AND PATCHING

A. The Contractor shall do necessary cutting of walls, floors, ceilings and roofs.

B. No structural member shall be cut without permission from Architect and Structural Engineer.

C. Patch around openings to match adjacent construction.

D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.7 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Fire Suppression Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Fire Suppression Contractor shall clean material and equipment installed under the Fire Suppression Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.8 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:

1. Submit complete Operation and Maintenance Manuals.
2. Submit complete Record Drawings.
3. Perform special inspections.
4. Start-up testing of systems.
5. Removal of temporary facilities from the site.
6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, they shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with Fire Suppression installations as follows:

1. Access panels and doors in walls, ceilings, and floors for access to Fire Suppression materials and equipment.

2. Concrete for bases and housekeeping pads.
3. Non-shrink grout for equipment installations.
4. Miscellaneous metals for support of Fire Suppression materials and equipment.
5. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Fire Suppression materials and equipment.
6. Joint sealers for sealing around Fire Suppression materials and equipment.

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

1. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
2. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
3. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
4. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Division 1 and Division 21 Section “General Fire Suppression Requirements”.

1. Product data for the following products:

a. Access panels and doors.
b. Through and membrane-penetration firestopping systems.

2. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

    a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

1.3 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

    1. Provide UL Label on each fire-rated access door.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

Acceptable Manufacturers:

1. Bar-Co., Inc.
2. Elmdor Stoneman.
3. JL Industries
4. Jay R. Smith Mfg. Co.
5. Karp Associates, Inc.
6. Milcor
7. Nystrom Building Products
8. Wade
9. Zurn

B. Access Doors:

1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Fire Suppression Piping and Equipment” for labeling of access doors.
2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Architect prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and

seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

    a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
    b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
    c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.

7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

    a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

8. Locking Devices: Flush, screwdriver-operated cam locks.

2.2 FIRE SUPPRESSION EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated Fire Suppression equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.3 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.4 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number

3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

1. Framing materials shall be fire resistant treated for use in Type I and II buildings.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

1. Framing materials shall be fire resistant treated for use in Type I and II buildings.

2.5 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:

a. "Dow Corning 790," Dow Corning Corp.
b. "Silglaze II SCS 2801," General Electric Co.
c. "Silpruf SCS 2000," General Electric Co.
d. "864," Pecora Corp.
e. "Rhodia 5C," Rhone-Poulenc, Inc.
f. "Spectrem 1," Tremco, Inc.
g. "Spectrem 2," Tremco, Inc.
h. "Dow Corning 795," Dow Corning Corp.
i. "Rhodia 7B," Rhone-Poulenc, Inc.
j. "Rhodia 7S," Rhone-Poulenc, Inc.
k. "Omniseal," Sonneborn Building Products Div.

2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:

a. "Dow Corning 786," Dow Corning Corp.
b. "Sanitary 1700," General Electric Co.
c. "898 Silicone Sanitary Sealant," Pecora Corp.
d. "OmniPlus," Sonneborn Building Products Div.

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Chem-Calk 600," Bostik Construction Products Div.
b. "AC-20," Pecora Corp.
c. "Sonolac," Sonneborn Building Products Div.
d. "Tremflex 834," Tremco, Inc.

2.6 ACOUSTICAL SEALANTS

A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.

B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.

C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.

D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m3).

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.3 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.4 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.5 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.6 PENETRATIONS:

A. New Construction:

1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping penetrations.

B. Construction in Existing Facilities:

1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.

C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.

D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.

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

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

I. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

J. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 21 Section “Basic Fire Suppression Piping Materials and Methods

END OF SECTION

SECTION 210515 - BASIC FIRE SUPPRESSION PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section specifies piping materials and installation methods common to more than one Section of Division 21 and includes piping, joining materials, piping specialties and basic piping installation instructions.

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

1. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
3. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
4. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.

1.2 SUBMITTALS

A. Refer to Division 1 and Division 21 “General Fire Suppression Requirements” for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:

1. Piping and Fittings
2. Escutcheons
3. Dielectric Unions and Fittings
4. Sleeves and Mechanical Sleeve Seals
5. Wall Pipes

1.3 QUALITY ASSURANCE

A. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.

B. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.

C. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.

D. UL and FM Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled, and Factory Mutual approved (FM Insureds only) for fire service.

E. Pipe, piping specialties and fittings shall be manufactured in plants located in the United States.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL REQUIREMENTS

A. All fire suppression system materials and components essential to successful system operation shall be listed for their intended purpose.

B. General: Refer to the individual piping system specification sections in Division 21 for specifications on piping and fittings relative to that particular system.

2.2 STEEL PIPE AND FITTINGS

A. All piping 2-inch and smaller:

1. With the use of welded or roll grooved fittings: ASTM A135 or 795, Grade A, Schedule 10 or 40, seamless or ERW, black steel pipe.
2. With the use of threaded fittings: ASTM A135 or 795, Grade A, Schedule 40, seamless or ERW, black steel pipe. All 1-inch piping shall have threaded ends.

B. All piping 2-1/2" and larger: ASTM A135 or 795, Grade A, Schedule 10, ERW, black steel pipe, roll grooved ends.

C. Piping used in dry pipe and preaction sprinkler systems shall be ASTM A135 or 795, Type E, Grade A, Schedule 40, black steel pipe, threaded or roll grooved ends.

D. All piping on the exterior of the building shall be externally galvanized.

E. Acceptable alternatives to Schedule 40 and Schedule 10 pipe shall be manufactured to standards recognized by NFPA 13. Threaded pipe shall have a corrosion resistance rating (CRR) of 1.0 or greater. Crimp type couplings shall not be used. Threadable thinwall pipe with CRR less than 1.0 not permitted.

F. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

G. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

H. Steel Couplings: ASTM A 865, threaded

I. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

J. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

K. Malleable- or Ductile-Iron Unions: UL 860.

L. Cast-Iron Flanges: ASME 16.1, Class 125.

M. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

N. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

O. Grooved-Joint, Steel-Pipe Appurtenances

1. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
2. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
3. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

2.3 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Check Valves:

1. Description: Swing-check type, rubber-face checks unless otherwise indicated, and ends matching piping.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

1. Description: Bronze body and bonnet and bronze stem.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded or grooved.

D. Iron OS&Y Gate Valves:

1. Description: Iron body and bonnet and bronze seating material.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.

4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Standard: UL 1091.
2. Pressure Rating: 175 psig minimum.
3. Valves NPS 2 and Smaller:

   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded or grooved.

4. Valves NPS 2-1/2 and Larger:

   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged or grooved.

5. Valve Operation: Integral, prewired supervisory switch and visual indicating device.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing (FM insureds only).
2. Pressure Rating: 175 psig minimum.

B. Automatic (Ball Drip) Drain Valves:

1. Standard: UL 1726.
2. Pressure Rating: 175 psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

2.7 AUTOMATIC AIR RELEASE VALVE

A. Standard: UL 2573

B. Pressure Rating: 175 psig minimum.

2.8 PIPING SPECIALTIES

A. Escutcheons: Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
2. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
3. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
4. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

B. Floor Plates: Inside diameter shall closely fit pipe outside diameter. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

1. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
2. Split-Casting Floor Plates: Cast brass with concealed hinge.

C. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

D. Dielectric Unions and Fittings: Provide factory-fabricated dielectric unions and fittings with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

E. Pressure Gauges

1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch diameter.
3. Pressure Gage Range: 0 to 300 psig.
4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

2.9 PENETRATIONS

A. Sleeves:

1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.

3. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.
4. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

B. Wall Pipes

1. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.

a. Underdeck Clamp: Clamping ring with setscrews.

C. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

a. Pressure Plates: Carbon steel or stainless steel.
b. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.2 PIPING INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Coordinate installation of horizontal piping with other components. Allow sufficient space above removable ceiling panels to allow for panel removal (minimum 6" clearance).

C. Install system such that all piping is rigidly secured and supported. All ductwork, lights, structural members and main runs of piping shall take precedence over sprinkler piping. Cutting of structural members for passage of sprinkler pipes or hangers shall not be permitted. All horizontal piping in ceiling space shall be at an elevation above the top of light fixtures and air outlets to allow for access to light fixtures and air outlets without removing horizontal piping. Route all sprinkler piping and provide all offsets, bends, and elbows around all mechanical, electrical, and structural members as required.

D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise. In areas with ceilings, piping shall be routed concealed, above ceiling. In areas without ceilings, piping shall extend as high as possible.

E. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.

F. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.

I. Install sprinkler piping to provide for system drainage in accordance with NFPA 13. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple and cap.

J. Coordinate pipe routing near electrical equipment in accordance with NFPA 70.

K. Verify final equipment locations for roughing in.

L. Deviations from approved "Working Plans" for sprinkler piping require written approval of the Authority Having Jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "Working Plans."

M. Install escutcheons for exposed piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

C. Install unions in pipes NPS 2 and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

D. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

E. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems.

F. Non-ferrous Pipe Joints:

1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping.
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

G. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

H. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads and Pipe Fitter’s Handbook. Join pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads.

4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads that are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

I. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9. Align flanged surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

J. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Joints for other piping materials are specified within the respective piping system sections.

3.4 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision.

B. Supervisory Switches: Supervise valves in open position unless noted otherwise.

1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

C. Locking and Sealing: Secure unsupervised valves as follows:

1. Valves: Install chain and padlock on open OS&Y gate valve.
2. Post Indicators: Install padlock on wrench on indicator post.

D. Water-Flow Indicators: Install in fire suppression piping where indicated. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

E. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

3.5 PIPING PROTECTION

A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at the end of each day or whenever work stops.

3.6 PENETRATIONS

A. Fire suppression penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.

B. Above Grade Concrete or Masonry Penetrations

1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:

   a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
   b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
   c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:

      1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
      2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).

   d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.

2. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

C. Elevated Floor Penetrations of Waterproof Membrane:

1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum ½" annular space between pipe and wall pipe.

2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
3. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."

5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.

D. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of sealant. Refer to Division 21 Section "Common Work Results for Fire Suppression" for materials and installation.

1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.

E. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.

F. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 21 Section "Common Work Results for Fire Suppression" for firestopping and materials.

3.7 ACOUSTICAL PENETRATIONS

A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the Fire Suppression equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.

B. Fire Sprinkler Piping

1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

3.8 PIPE FIELD QUALITY CONTROL

A. Testing: Refer to individual piping system specification sections.

END OF SECTION

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of Fire Suppression work to be identified as required by this Section is indicated on drawings and/or specified in other Division 21 Sections.

B. Types of identification devices specified in this Section include the following:

1. Valve tags.
2. Hydraulic placards.

C. Related Sections

1. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
4. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.

1.2 CODES AND STANDARDS:

A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Maintenance Data: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, stainless steel, aluminum or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain or S-hook.
3. Valve-Tag Color: Red.
4. Letter Color: White.

2.2 HYDRAULIC PLACARDS

A. Provide hydraulic calculation placard attached to each riser in accordance with NFPA 13. Placard shall include location of design area or areas, discharge densities over the design area or areas, required flow and pressures at the base of riser, occupancy classification and maximum permitted storage height and configuration, hose stream allowance included in addition to the sprinkler demand and name of installing contractor. Information shall be permanently and clearly displayed on placard.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire suppression systems

3.3 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major piece of equipment.

D. Locate equipment labels where accessible and visible.

END OF SECTION

SECTION 211313 - WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. The extent of this fire sprinkler system shall be as specified herein. Contractor shall be responsible for preparation of design drawings, hydraulic calculations, fabrication and installation for complete fire sprinkler protection for the building.

B. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire protection valves.
3. Sprinkler pipe fittings.
4. Sprinklers.
5. Alarm devices.

C. Related Sections:

1. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
4. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.

1.2 SYSTEM DESCRIPTION

A. Fire protection system in the location or portion of the building is a combination of Wet Pipe and Dry Pipe Systems.

1. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to a water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts a fusible link or destroys a frangible device. Hose connections are included if indicated.
2. Dry Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open a dry pipe valve. Water then flows into piping and discharges from sprinklers that are open.

B. Provide system(s) as specified herein and as shown on drawings. The sprinkler system shall be supplied by the existing underground and riser as shown on the Drawings.

C. Provide dry pipe fire protection system for non-heated spaces and other areas of building subject to freezing including the loading docks and canopies, mansards, and balconies. Portions of systems subject to freezing or temperatures below 40° F shall be protected against freezing as required by NFPA 13. The Contractor shall be responsible for repairs and for all costs incurred from damage caused by freezing of the fire protection system.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design fire suppression system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Standard Pressure, Fire Suppression System Component: Listed for 175-psig minimum working pressure.

C. High Pressure, Fire Suppression System Component: Listed for 250-psig minimum working pressure.

D. Performance Criteria

1. Protect entire area of work, unless noted otherwise, with a sprinkler system designed in accordance with NFPA 13 for Ordinary Hazard Group 2 requirements.
2. Protect mechanical and electrical areas/rooms with a sprinkler system designed in accordance with NFPA 13 for Ordinary Hazard Group 1 requirements.
3. Protect storage areas/rooms, unless noted otherwise, with a sprinkler system designed in accordance with NFPA 13 for Ordinary Hazard Group 2 requirement.

4. Other Occupancy Hazard Classifications.

   a. Building Service Areas: Ordinary Hazard Group 1.
   b. Automobile Parking Areas: Ordinary Hazard, Group 1.
   c. Laundries: Ordinary Hazard, Group 1.
   d. Machine Shops: Ordinary Hazard, Group 2.
   e. Office and Public Areas: Light Hazard.

5. Design Criteria for Automatic-Sprinkler Piping Design:

   a. Light Hazard Occupancy:

      1) Minimum Design Density: 0.10 gpm over 1,500 sq.ft. area.
      2) Maximum protection area per sprinkler: 225 sq.ft.
      3) Minimum Combined Hose Stream Demand Requirement: 100 gpm for 30 minutes.

b. Ordinary Hazard Group 1 Occupancy:

1) Minimum Design Density: 0.15 gpm over 1,500 sq.ft. area.
2) Maximum area per sprinkler: 130 sq.ft..
3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.

c. Ordinary Hazard Group 2 Occupancy:

1) Minimum Design Density: 0.20 gpm over 1,500 sq.ft. area.
2) Maximum protection area per sprinkler: 130 sq.ft.
3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.

E. The criteria listed herein shall not preclude the use of extended coverage or special application fire sprinklers designed and installed in accordance with their listing and manufacturer's instructions.

F. The hydraulic area of operation may not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers in unfinished shell spaces. For all other areas, the hydraulic area of operation shall not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers unless specifically approved by the Engineer via a formally submitted RFI.

G. Sprinkler spacing shall conform to NFPA 13 and shall not exceed 256 SF per sprinkler in unfinished shell spaces.

H. The hydraulic area of operation shall be increased by 30% without revising the density for areas with sloped ceilings with a pitch exceeding 1 in 6 (16.7% slope) in accordance with NFPA 13.

I. The hydraulic area of operation shall be increased by 30% without revising the density for dry-pipe systems in accordance with NFPA 13.

1.4 SUBMITTALS

A. Submit shop drawings prepared in accordance with NFPA 13 as specified in Division 21 Section 210010 "General Fire Suppression Requirements."

1.5 QUALITY ASSURANCE

A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of a fire sprinkler system.

B. Tests and Inspections: Arrange, test, and pay for all tests required by code and authorities having jurisdiction.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Fire Sprinkler Protection: Do not interrupt fire sprinkler system protection to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire sprinkler protection according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of fire-sprinkler protection.
2. Do not proceed with interruption of fire sprinkler protection without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.8 EXTRA MATERIALS

A. Sprinkler Wrenches: Furnish to Owner, 2 sprinkler wrenches for each type of sprinkler installed.

B. Sprinklers: Furnish extra sprinklers of each style, type and finish included in the project as required by NFPA 13.

C. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet(s), suitable for wall mounting, with hinged cover and space for the quantity of spare sprinklers provided plus sprinkler wrench(es).

D. Provide hydraulic calculation placard attached to each riser.

PART 2 - PRODUCTS AND MATERIALS

2.1 EQUIPMENT

A. All fire protection equipment shall be UL listed for its intended use and in conformance with the applicable NFPA documents.

2.2 PIPE AND FITTING MATERIALS

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for specifications on piping and fittings.

2.3 HANGERS

A. Shall be UL listed and shall meet requirements of NFPA 13 for type, dimension and location.

2.4 GENERAL DUTY VALVES

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for specifications on general duty valves.

2.5 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by Factory Mutual, approval.
2. Pressure Rating:

    a. Standard Pressure Piping Specialty Valves: 175-psig minimum.
    b. High Pressure Piping Specialty Valves: 250-psig minimum.

3. Body Material: Cast- or ductile- iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Standard: UL 193.
2. Design: For horizontal or vertical installation.
3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.

4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Dry-Pipe Valves:

1. Standard: UL 260.
2. Design: Differential-pressure type.
3. Include UL 1486, quick-opening devices, trim sets for bypass, air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, drip cup assembly piped with check valve to main drain piping, priming chamber attachment, and fill-line attachment with strainer.
4. Air-Pressure Maintenance Device:

    a. Type: Automatic device to maintain minimum air pressure in piping.

b. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

5. Air Compressor:

a. Type: Oil-less, air-cooled
b. Standard: UL's "Fire Protection Equipment Directory" listing.
c. Motor Horsepower: Fractional.

d. Power: 120-V ac, 60 Hz, single phase, hard wired per NEC and manufacturer's requirements.
e. Provide combination fused disconnect switch and magnetic starter.

D. Air Release Valve:

1. Provide for all wet pipe sprinkler systems utilizing metallic piping in accordance with one of the following options:

a. Manual ball valve with a minimum size of ½ inch (15 mm).
b. Listed and/or Factory Mutual Approved automatic valve.

2.6 PIPE FITTINGS

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, welded or threaded.

B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Grooved or threaded.

C. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

D. Flexible Piping Systems:

1. At Contractor's option, UL listed and FM approved flexible piping connections to sprinklers may be used for both acoustical panel and gypsum board ceilings when suitable for their intended use. Piping shall be seismically qualified per ICC-ES AC-156 where required.
2. Description: Connections shall include a leak-tested sprinkler drop with a minimum internal corrugated hose diameter of 1 inch.
3. Flexible piping lengths shall not exceed 6 feet.
4. Installation shall not exceed the minimum bend radius and maximum allowable bends as specified by the manufacturer.
5. Change in direction shall be gradual enough to allow flexible piping to bend without crimping, distorting or reducing internal diameter.

2.7 AUTOMATIC SPRINKLERS

A. Sprinklers: type and style as indicated or required by application. Sprinkler operating temperatures to comply with NFPA 13. Sprinklers in Light Hazard areas shall be quick response type.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
2. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Use sprinkler types below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers .
3. Rooms with Gypsum Board Ceilings: Recessed sprinklers .
4. Wall Mounting: Sidewall sprinklers.
5. Spaces Subject to Freezing: Dry pendent or dry sidewall sprinklers as indicated on drawings.

E. Provide sprinkler types below with finishes indicated.

1. Finished Areas:

a. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon .
b. Upright, Pendent, and Sidewall Sprinklers: Bright chrome, with bright chrome escutcheon .
c. Unfinished Areas: Rough bronze in unfinished spaces not exposed to view.

F. Coordinate sprinkler temperature ratings near heat-producing sources in accordance with NFPA 13.

G. Sprinklers shall be wax coated where exposed to acids, chemicals, or other corrosive fumes.

H. Sprinkler Guards: Provide sprinkler guard where sprinklers are less than 7-feet above finished floor; where subject to physical damage, and/or where indicated on drawings. Guard shall be UL 199 listed, wire cage type with fastening device for attaching to sprinkler.

I. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet, suitable for wall mounting, with hinged cover and space for the appropriate quantity of spare sprinklers plus sprinkler wrench(es).

2.8 ALARM DEVICES

A. General: Alarm device types shall match piping and equipment connections.

B. Water Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field-adjustable retard element to prevent false signals and tamperproof cover.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

C. Pressure Switches – Water Flow Alarm Detection:

1. Standard: UL 346.
2. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field adjustable retard element to prevent false signals and tamperproof cover.
3. Type: Electrically supervised water flow switch with retard feature.

4. Pressure Rating: 250 psig.
5. Design Operation: Rising pressure signals water flow.

D. Pressure Switches – Low/High Air Pressure Supervisory:

1. Standard: UL 346.
2. Components: Two single-pole, double-throw circuit switches for isolated alarm contacts, 7 A, 125-V ac and 0.25 A, 24-V dc.
3. Type: Electrically supervised pressure supervisory switch
4. Pressure Rating: 250 psig.
5. Design Operation: Rising pressure signals excessive supervisory air pressure within the system piping, with lowering pressure signals lack of air pressure within the system piping.

E. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
4. Design: Signals that controlled valve is in other than fully open position.

F. Indicator Post Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
4. Design: Signals that controlled indicator post valve is in other than fully open position.

2.9 SPRINKLER WATERFLOW AND SUPERVISORY SYSTEM

A. The sprinkler waterflow and supervisory system is existing to remain. Provide necessary equipment ad connection as required for monitoring of sprinkler system components.

B.

1. UL listed, microprocessor based fire alarm control/communicator that provides addressable point monitoring or supports a minimum of 5 zones providing supervising station service. Microprocessor shall be capable of continuously monitoring and reporting system status of AC, standby battery, inputs and telephone line connections. In the event of a fault condition a local audible sound shall be activated and reported to supervising station.
2. Shall have one notification appliance circuit for connection of the exterior bell or horn/strobe.
3. A keypad shall be provided and mounted adjacent to the fire sprinkler remote dialer.

4. Power requirements: primary power, 20-V ac, 60 Hz, 600 mA max; secondary rated 18-V ac, 40 VA. Backup battery: 12-V dc, 7 AH min to 14 AH max, lead acid (gel type).
5. Provide two telephone lines for off site system monitoring in accordance with NFPA 72. Other monitoring methods permitted by NFPA 72 may be used subject to Engineer approval.

C. Supervisory System Wire and Cable

1. Power Branch Circuits: Building wire as specified in Division 26.
2. Fire alarm Wire and Cable: NRTL listed and labeled as complying with NFPA 70 (NEC) Article 760. All wiring, including wiring to existing modified devices and appliances shall be new.
3. Signaling Line, Initiating Device and Notification Appliance Circuits: Power limited fire protective signaling cable, solid copper conductor, 300 volts insulation, suitable for temperature, conditions and location installed. Minimum wire size for initiating device circuits, control circuits and notification appliance circuits shall be determined by calculations and manufacturer's requirements or recommendations. Wire and cable shall be twisted and shielded if recommended by the system manufacturer.
4. The type of cable chosen should be based on fire alarm system requirements, specification requirements and applicable code requirements. Consideration should also be given to the length of cable runs and potential interference.
5. Initiating, notification, and control circuits shall be sized based on 20% additional power consuming devices.

6. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

3.2 PREPARATION

A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

3.3 WATER SUPPLY CONNECTION

A. Connect sprinkler piping to water service piping for service entrance to building. Do not connect to underground supply until provided with written documentation that piping has been flushed and pressure tested in accordance with NFPA 13. Comply with

requirements for exterior piping in Division 21 Section 211100 “Fire Suppression Water Service Piping."

B. Wet pipe systems shall be equipped with a listed relief valve not less than ½-inch in size and set to operate at 175 psi or 10 psi in excess of the maximum system pressure, whichever is greater.

3.4 PIPE APPLICATIONS

A. Piping Above Grade: Refer to Division 21 Section 210515 “Basis Fire Suppression Piping Materials and Methods.”

3.5 PIPING INSTALLATIONS

A. Refer to Division 21 Section 210515“Basic Fire Suppression Piping Materials and Methods” for general fire suppression piping installation requirements.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake if required by the applicable building code, designed in accordance with NFPA 13. Locate hangers at or directly adjacent to the joist panel points. Provide two nuts on threaded supports to securely fasten the support.

D. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.

E. Install pressure gauge on the riser or feed main at or near each test connection. Provide pressure gauge with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

F. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

G. Drain dry-type sprinkler system piping.

H. Fill wet-type sprinkler system piping with water.

I. Connect compressed air supply to dry pipe sprinkler piping.

J. Connect air compressor to the following piping and wiring:

1. Pressure gauges and controls.
2. Electrical power system.
3. Fire-alarm devices, including high- and low-pressure alarm.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods"

L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods."

3.6 PIPE JOINT CONSTRUCTION

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for general pipe joint construction requirements.

3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable water supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain line connection.

3.8 SPRINKLER INSTALLATIONS

A. Use proper tools to prevent damage during installations.

B. Areas with ceilings: Install sprinklers not less than 6-inches from the edge of a ceiling tile in areas with suspended ceilings, in a symmetrical pattern with lights and outlets.

C. Install sprinklers in a symmetrical pattern with lights and outlets in all other areas with ceilings.

D. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

E. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

F. Do not install more than one sprinkler on a one inch outlet unless hydraulic calculations are included to verify performance.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment.”

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Perform required tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, “Systems Acceptance” Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire alarm tests. Operate as required.
7. Coordinate with fire pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire department equipment.

C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 COMMISSIONING

A. Sprinkler Systems: Test per NFPA 13, NFPA 25 and local authorities requirements. Submit Contractor's Material & Test Certificates for Above Ground Piping. Submit certificates of completion to Authority Having Jurisdiction and Owner.

1. After completion of all installation, tests, etc., and prior to the opening date, the Sprinkler Subcontractor shall instruct the building personnel in the operation of the sprinkler system. Special care shall be taken to make sure the building personnel:

a. Will immediately recognize whether the system control valves are in an 'Open' position or a 'Closed' position.
b. Will know how to drain the system.

c. Will know how to test the flow switches, tamper switches and alarm system.
d. Will know how to test the dry pipe valve.
e. Will know how to make complete weekly inspection.
f. Will know how to perform periodic maintenance of the Fire Sprinkler System.

B. Fire Alarm Equipment: Test per NFPA 25, NFPA 72 and local authorities requirements in the presence of the Owner. Submit certificates of completion to authority having jurisdiction and Owner.

END OF SECTION

SECTION 220010 - GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturer’s requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

ADA	American Disabilities Act
AIA	Guidelines for Design and Construction of Hospital and Healthcare Facilities
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
MSS	Manufacturer’s Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
UL	Underwriter's Laboratories

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. Furnish: The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”
4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.

5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.

    a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

9. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Bedding: as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
6. Drainage Fill: as used in this Section refers to gravel installed to assist in the removal of underslab groundwater.
7. Building Fill: as used in this section refers to borrowed fill material of rock 1” and larger used to fill foundation excavations.

1.5 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor

shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.

C. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.

D. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

E. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

A. Refer to Division 1 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples and other submittals required by this Division as noted in Table 1 at the end of this Section. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual Sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before Plumbing construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer’s designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with

actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

L. Provide welders' qualification certificates.

1.8 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.9 SUBSTITUTIONS

A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:

1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:

    a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
    d. Same warranty will be furnished for proposed substitution as for specified Work.

e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:

1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
2. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain data listed in Table 5.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.11 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification. Refer to Table 2 at the end of this section for a list of specification sections in Division 22 that contain spare parts requirements.

B. Owner or Owner's representative shall initial and date each section line in Table 2 when the specified spare parts for that section are received and shall sign at the bottom when all spare parts have been received.

1.12 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports [and exposed insulated piping] shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:

1. Piping shall be free from obstructions, holes or breaks of any nature.
2. Insulation shall be effective.
3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

PART 2 - PRODUCTS AND MATERIALS

2.1 SOIL MATERIALS

A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).

B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.

C. Drainage Fill: Provide washed, evenly graded mixture of ¾" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.

D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4,480 to 13,440 L/min. per sq. m) when tested according to ASTM D 4491.

PART 3 - EXECUTION

3.1 PERMITS

A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 EXISTING UTILITIES

A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.

B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.

C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.

D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.

E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.3 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.

C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.

D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.

E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.

F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.

1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches for Plumbing installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.

4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.

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

N. Bedding:

1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.

O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.

4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.
5. Other areas, use excavated or borrowed materials.

P. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

Q. Drainage Fill: Where building fill is used in lieu of natural soils, provide drainage fill as subbase material. Provide filter fabric material to line the trench to support the bedding material and subbase materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.

R. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

S. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

T. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

U. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
2. For vertical and/or diagonal pipe installations greater than ½" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

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

W. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

3.4 CUTTING AND PATCHING

A. The Contractor shall do necessary cutting of walls, floors, ceilings and roofs.

B. No structural member shall be cut without permission from Architect.

C. Patch around openings to match adjacent construction.

D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.5 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.6 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:

1. Submit complete Operation and Maintenance Manuals.
2. Submit complete Record Drawings.
3. Perform special inspections. Refer to Table 4 at the end of this section for a list of specification sections in Division 22 that contain special inspection requirements.
4. Start-up testing of systems.
5. Removal of temporary facilities from the site.
6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

TABLE 1: PLUMBING SPECIFICATION SHOP DRAWING SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220010	General Plumbing Requirements	NONE
220015	Coordination	NONE
220500	Common Work Results For Plumbing	A, B, G, M
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B, G
220516	Expansion Fittings And Loops For Plumbing Piping	A, B, F
220519	Meters And Gauges For Plumbing Piping	B, H
220523	General-Duty Valves For Plumbing Piping	B
220529	Hangers And Supports For Plumbing Piping	B, F, G, H
220533	Heat Tracing For Plumbing Piping	A, B, E, F
220548	Seismic Controls For Plumbing Piping & Equipment	A, B, C, D, I, M
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C, F, I, J
220553	Identification For Plumbing Piping & Equipment	B, L, M
220700	Plumbing Insulation	B, M
221100	Water Distribution Piping & Specialties	B, G, H
221111	Mechanically Joined Plumbing Piping Systems	B, G, H
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	B, G, H
221113	Polypropylene Water Distribution Piping and Specialties	B, G, H
221114	Stainless Steel Water Distribution Piping and Specialties	B, G, H
221115	CPVC Water Distribution Systems & Specialties	B, G, H
221123	Domestic Water Pumps	A, B, C, E
221300	Sanitary Drainage & Vent Piping & Specialties	B
221329	Sanitary Sewerage Pumps	A, B, C, E
221400	Storm Drainage Piping & Specialties	B
221410	Siphonic Storm Drainage Piping & Specialties	A, B, I
221489	Sump Pumps	A, B, C, E
221500	General Service Compressed Air Systems	B, C, D, E, F, H
221510	Beverage System Bulk CO2 Systems	B, N
223100	Water Softeners	B, C, E, K
223120	Water Filtration Systems	B, C, E, K
223130	Copper Silver Ionization System	B, C, E, K
223140	Chlorine Dioxide System	B, C, E, K
223200	Domestic Water Filtration Equipment	B, C, E, K
223300	Electric Domestic Water Heaters	B, C, E, F, H, K
223400	Fuel Fired Domestic Water Heaters	B, C, E, F, H, K
223500	Domestic Water Heat Exchangers	B, C, E, F, H, K
224000	Plumbing Fixtures	B, E, N
226100	Gas & Vacuum Systems For Medical Facilities	B, C, E, F, G
226200	Gas & Vacuum Systems For Laboratories	B, C, E, F, G
226600	Chemical Waste Systems For Laboratory And Medical Facilities	B, C, E, F, G
226700	Process Water Piping And Equipment For Laboratory And Healthcare Facilities	B, C, E, F, G
227000	Natural Gas Systems	A, B, C, D, F, G

227010	Mechanically Joined Natural Gas Piping Systems	B, F, H, N
228000	Beverage Conduit Systems	A, B, D, F

CODED LEGEND

A	Shop Drawings
B	Product Data and equipment weights
C	Performance Data, Curves, Certificates and Test Data
D	Coordination Drawings
E	Wiring Diagrams and short circuit current ratings
F	Installation Instructions
G	Welder's Certificates
H	Certificates
I	Calculations
J	Special Inspections
K	Special Warranties
L	Material Samples
M	Schedules
N	Recommended Spare Parts List

TABLE 2: SPARE PARTS REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
220553	Identification For Plumbing Piping & Equipment	_____
221100	Water Distribution Piping & Specialties	_____
221111	Mechanically Joined Plumbing Piping Systems	_____
221112	GENERAL PLUMBING REQUIREMENTS & Specialties _____	
224000	Plumbing Fixtures	_____
221123	Domestic Water Pumps	_____
221510	Beverage System Bulk CO2 Systems	_____
[221329	Sanitary Sewerage Pumps	_____]
[221489	Sump Pumps	_____]
223100	Water Softeners	_____
223120		Water Filtration Systems
223130	Copper Silver Ionization System	_____
223200	Domestic Water Filtration Equipment	_____
223140		Chlorine Dioxide System
22610	Gas & Vacuum Systems For Medical Facilities	_____
226200	Gas & Vacuum Systems For Laboratories	_____
227000	Natural Gas Systems	_____

_____
Owner's Signature

TABLE 3: SPECIAL WARRANTY REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
223100	Water Softeners	_____
22320	Domestic Water Filtration Equipment	_____
223300	Electric Domestic Water Heaters	_____
223400	Fuel Fired Domestic Water Heaters	_____

TABLE 4: SPECIAL INSPECTION REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		COMPLETED/DATE/INITIAL
220548	Seismic Controls For Plumbing Piping & Equipment	_____
220550	Vibration Isolation For Plumbing Piping & Equipment	_____
226100	Gas & Vacuum Systems For Medical Facilities	_____

TABLE 5: PLUMBING SPECIFICATION OPERATION AND MAINTENANCE SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE	CODE

DESIGNATION

220500	Common Work Results For Plumbing	B
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B
220516	Expansion Fittings And Loops For Plumbing Piping	A, B
220519	Meters And Gauges For Plumbing Piping	B, G, I
220523	General-Duty Valves For Plumbing Piping	B, H, I
220529	Hangers And Supports For Plumbing Piping	B
220533	Heat Tracing For Plumbing Piping	B, C, E, G, I
220548	Seismic Controls For Plumbing Systems	A, B, C
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C
220553	Identification For Plumbing Piping & Equipment	B
220700	Plumbing Insulation	B
221100	Water Distribution Piping & Specialties	A, B, F, H, I
221111	Mechanically Joined Plumbing Piping Systems	A, B, F, H, I
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	A, B, F, H, I
221113	Polypropylene Water Distribution Piping and Specialties	A, B, F, H, I
221114	Stainless Steel Water Distribution Piping and Specialties	A, B, F, H, I
221115	CPVC Water Distribution Systems & Specialties	A, B, F, H, I
221123	Domestic Water Pumps	B, C, D, E, G, H, I
221300	Sanitary Drainage & Vent Piping & Specialties	A, B, F
221329	Sanitary Sewerage Pumps	B, C, D, E, G, H, I
221400	Storm Drainage Piping & Specialties	A, B, F
221410	Siphonic Storm Drainage Piping & Specialties	A, B, F
221489	Sump Pumps	B, C, D, E, G, H, I
221500	General Service Compressed Air Systems	A, B, C, D, E, G, H, I
221510	Beverage System Bulk CO2 Systems	A, B, F, H
223100	Water Softeners	B, C, D, E, G, H, I
223120		Water Filtration Systems B, C, D, E, G, H, I
223130	Copper Silver Ionization System	B, C, D, E, G, H, I
223140		Chlorine Dioxide System B, C, D, E, G, H, I
223200	Domestic Water Filtration Equipment	B, C, E, G, H, I
223300	Electric Domestic Water Heaters	B, C, D, E, G, H, I
223400	Fuel Fired Domestic Water Heaters	B, C, D, E, G, H, I
223500	Domestic Water Heat Exchangers	B, C, E, G, I
224000	Plumbing Fixtures	B, E, H, I
226100	Gas & Vacuum Systems For Medical Facilities	A, B, C, D, E, G, H, I
226200	Gas & Vacuum Systems For Laboratories	A, B, C, D, E, G, H, I
226600	Chemical Waste Systems For Laboratory And Medical Facilities	B, C, E, F, H
226700	Process Water Piping And Equipment For Laboratory And Healthcare Facilities	A, B, C, D, E, G, H, I
227000	Natural Gas Systems	A, B, C, H
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H
228000	Beverage Conduit Systems	A, B

CODED LEGEND

A	As-Built Drawings
B	Product Data
C	Performance Data, Capacities, Curves and Certificates
D	Wiring Diagrams
E	Operating Instructions
F	Test Reports
G	Warranties
H	Recommended Spare Parts List
I	Service and Maintenance Instructions

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

SECTION 220015 - COORDINATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section specifies the basic requirements for electrical components which are an integral part of packaged plumbing equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.

C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.3 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Plumbing Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Plumbing Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.

B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections

C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.

B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV 22	DIV 22	DIV 26	---
Factory furnished motor starters, contactors and disconnects	DIV 22	DIV 26	DIV 26	DIV 23
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV 26	DIV 26	DIV 26	DIV 23
Control relays and transformers	DIV 22	DIV 22	DIV 26	DIV 23
Thermostats (line voltage)	DIV 22	DIV 22	DIV 26	---

DIV 22 = Plumbing Contractor
DIV 26 = Electrical Contractor
DIV 23 = Building Automation System Contractor

END OF SECTION

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with Plumbing installations as follows:

1. Access panels and doors in walls, ceilings, and floors for access to Plumbing materials and equipment.
2. Plumbing equipment nameplate data.
3. Concrete for bases and housekeeping pads.
4. Non-shrink grout for equipment installations.
5. Sleeves for Plumbing penetrations.
6. Miscellaneous metals for support of Plumbing materials and equipment.
7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
8. Joint sealers for sealing around Plumbing materials and equipment.

9. Plenum insulation for enclosure of combustible items located within fire-rated return air plenums.

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

1. Division 7 Section “Penetration Firestopping” for material and methods for firestopping systems.

2. Division 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
3. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for indirect drain piping and installation requirements.
4. Division 23 Section “Direct Digital Controls for HVAC” for integration with building automation system of leak detection system “Water Present” alarm.
5. Division 26 Section “Common Work Results for Electrical” required electrical devices.
6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Division 1 and Division 22 Section “General Plumbing Requirements”.

1. Product data for the following products:

    a. Access panels and doors.
    b. Through and membrane-penetration firestopping systems.
    c. Joint sealers.

2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for Plumbing materials and equipment.

3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

    a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.

    a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

    1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

    1. Provide UL Label on each fire-rated access door.

C. Through and Membrane Penetration Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified

requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

PART 2 - PRODUCTS AND MATERIALS

2.1 PLUMBING EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated Plumbing equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.2 GROUT

A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.

B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.

C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.3 PENETRATIONS

A. Sleeves:

1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.

B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

C. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect.

Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.4 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.5 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 15/32 inches.

2.6 FIRESTOPPING

A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ. Manufactured by:

1. Hilti
2. RectorSeal
3. Specified Technologies Inc.,
4. United States Gypsum Company
5. 3M Corp.

PART 3 - EXECUTION

3.1 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.2 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.3 PENETRATIONS:

A. New Construction:

1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.

B. Construction in Existing Facilities:

1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.

C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.

D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.

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

H. Extend sleeves installed in floors 2 inches above finished floor level.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

K. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 22 Section “Basic Piping Materials and Methods”.

\END OF SECTION

SECTION 220515 - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section specifies piping materials and installation methods common to more than one Section of Division 22 and includes joining materials, piping specialties and basic piping installation instructions.

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

1. Division 22 Section "Common Work Results for Plumbing," for materials and methods for sleeve materials.

1.2 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

A. Refer to Division 1 and Division 22 Section “General Plumbing Requirements” for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:

1. Escutcheons
2. Dielectric Unions
3. Dielectric Waterway Fittings
4. Dielectric Flanges and Flange Kits
5. Mechanical Sleeve Seals
6. Wall Pipes
7. Strainers
8. Flexible Connectors

C. Quality Control Submittals:

1. Submit welders' certificates specified in Quality Assurance below.

D. Submit certification that specialties and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

E. Submit a schedule of dissimilar metal joints and dielectric waterway fittings, unions, flanges or flange kits. Include joint type materials, connection method and proposed dielectric waterway fittings, unions and flanges to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Refer to the individual piping system specification sections in Division 22 for specifications for piping materials and fittings relative to that particular system and additional requirements.

F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

1.4 QUALITY ASSURANCE

A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

B. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.

C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.

D. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:

1. Pipe Escutcheons:

a. AWI Manufacturing.
b. Keeney Manufacturing Company
c. Wal-Rich Corp.
d. Jones Stephens Corp.

2. Dielectric Waterway Fittings:

a. .

b. Grinnell Mechanical Products; Tyco Fire Products LP
c. Precision Plumbing Products, Inc.

3. Dielectric Unions:

a. JOMAR International
b. Smith Cooper International
c. Watts Regulator Co.
d. Zurn Industries

4. Dielectric Flanges and Flange Kits:

a. Calpico, Inc.
b. FMC Technologies
c. Pipeline Seal & Insulator, Inc.
d. Tampa Rubber and Gasket Co., inc.
e. Watts Industries Inc.; Water Products Div.
f. Zurn Industries, Inc.; Wilkins Div.

5. Strainers:

a. Armstrong Machine Works.
b. Hoffman Specialty ITT; Fluid Handling Div.
c. MEPCO
d. Metraflex Co.
e. Mueller Steam Specialties.
f. Nicholson Steam
g. RP&C Valve, Division of Conbraco Ind.
h. Spirax Sarco.
i. Watts Regulator Co.

6. Mechanical Sleeve Seals:

a. Advance Products & Systems
b. Calpico, Inc.
c. GPT Industries/Link Seal
d. Metraflex Co.
e. Proco Products, Inc.

7. Metal Flexible Connectors:

a. United Flexible, Inc.
b. Hyspan
c. Mason Industries, Inc.
d. Mercer Rubber Co.
e. Metraflex Co.
f. Proco Products, Inc.
g. Resistoflex
h. Tyler Pipe; Gustin-Bacon Div.

8. Rubber Flexible Connectors:

    a. General Rubber Corp.
    b. Mason Industries, Inc.
    c. Mercer Rubber Co.
    d. Metraflex Co.
    e. Proco Products, Inc.
    f. Uniflex, Inc.

9. Wall Pipes

    a. Josam Mfg. Co.
    b. Smith (Jay R) Mfg. Co.
    c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
    d. Watts Industries, Inc.
    e. Zurn Industries, Inc.; Hydromechanics Div.

2.2 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 Piping Sections for special joining materials not listed below.

B. Welding Materials: AWS D10.12; Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

C. Brazing Materials: AWS A5.8; Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

D. Soldering Materials: ASTM B32; Refer to individual piping system specifications for solder appropriate for each respective system.

E. Gaskets for Flanged Joints: ASME B16.21; Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.4 PIPING SPECIALTIES

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions:

1. Malleable-iron, Class 150 for low pressure service and class 300 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
2. Bronze, Class 125, with lead free cast bronze body meeting ASTM B584, for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; solder or female threaded ends.

C. Dielectric Unions: Factory-fabricated with lead free cast bronze body meeting ASTM B584 and galvanized steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

E. Dielectric Flanges and Flange Kits:

1. Full faced gasket with same outside diameter and bolt hole arrangement as the flange. Pressure rating of 200psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
2. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
3. Lead free cast bronze meeting ASTM B584, class 125 solder type or cast iron class 125 threaded type for low pressure service and bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.

F. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens for 4” and smaller shall be Type 304 stainless steel mesh with 0.062” perforations and screens for 5” and larger shall be Type 304 stainless steel, with 0.125" perforations.

1. For low pressure applications, cast iron strainers shall have 125 psi working pressure rating and cast bronze strainers shall have 150 psi working pressure rating. For high pressure applications, cast iron strainers shall have 250 psi working pressure rating and cast bronze strainers shall have 300 psi working pressure rating.
2. Solder Ends, 2” and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.

3. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

G. Sleeves:

1. Sleeve: Refer to Division 22 Section “Common Work Results for Plumbing” for sleeve materials.

H. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

I. Flexible Connectors: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections.

1. Stainless-Steel-Hose, Flexible Connectors: For 2” and smaller, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples with screwed connections, welded to hose.
2. Bronze Hose, Flexible Connectors: For 2” and smaller, corrugated bronze inner tubing covered with bronze wire braid. Include ANSI 150# brass nipples with screwed connections, braised to hose.
3. Stainless-Steel-Hose, Flexible Connectors: For 2-1/2” and larger, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples or flanges, welded to hose.

2.5 WALL PIPES

A. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.6 WALL SLEEVES

1. Steel sleeve of schedule 40 pipe meeting ASTM A53B with 2” wide metal plate meeting ASTM A36 welded all around. Hot dip galvanized inside and out.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s installation instructions.

3.2 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.3 INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

I. Verify final equipment locations for roughing in.

3.4 PIPING PROTECTION

A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.5 PENETRATIONS

A. Plumbing penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.

B. Above Grade Concrete or Masonry Penetrations

1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:

a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).

d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.

2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1” annular clear space between inside of sleeve and outside of insulation.
3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½” of sealant.

C. Underground, Exterior-Wall Penetrations: Provide galvanized steel wall sleeve. Wall sleeve is not required for existing concrete walls with core drilled penetrations. Size wall sleeves to allow for 1-inch or larger, if required by the mechanical sleeve seal manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.

1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
2. Verify sleeve and mechanical sleeve seal installations for damage and faulty work. Verify watertight integrity of sleeves and mechanical sleeve seals installed below

grade to seal against hydrostatic water pressure. If sleeve and or sleeve seal are not watertight, provide new wall sleeve and mechanical sleeve seal.

D. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.

E. Concrete Slab on Grade Penetrations:

1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
2. Provide ½" thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2" above and below the concrete slab.

F. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.

G. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.

3.6 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.

C. Install components with pressure rating equal to or greater than system operating pressure.

D. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, mixing valve, backflow preventer and elsewhere as indicated.

E. Install unions at the final connection to each piece of equipment adjacent to each isolation valve or valve assembly for connections 2" and smaller. Install unions where indicated elsewhere on the drawings.

F. Install flanges at the final connection to each piece of equipment, adjacent to each isolation valve or valve assembly in piping 2-1/2" and larger. Install flanges at each valve 2-1/2” and larger.

G. Install dielectric unions for piping 2” and smaller or dielectric flanges for piping 2-1/2” and larger to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.

H. Install dielectric unions for piping 2” and smaller or dielectric flanges for piping 2-1/2” and larger to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.

I. Install dielectric waterway fittings for piping 2” and smaller for copper or brass pipe connections to carbon steel equipment connections.

J. Install dielectric flanges for piping 2-1/2” and larger for copper or brass pipe connections to carbon steel equipment connections, steel, ductile iron or cast iron valves and fittings.

K. Dielectric Flange Installation:

1. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
2. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
3. Provide full face gasket with pressure rating equal to system served.
4. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

3.7 JOINTS

A. Steel Pipe Joints:

1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
2. Pipe Larger Than 2":

a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.9 Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:

1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping and ANSI B9.1 - Standard Safety Code for Plumbing Refrigeration.
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

C. Joints for other piping materials are specified within the respective piping system Sections.

3.8 FLEXIBLE CONNECTORS

A. Install flexible connectors for piping system connections on equipment side of shutoff valves for all Plumbing equipment, pumps, and where indicated on Drawings.

1. Install stainless steel connectors for domestic water copper equipment connections 2” and smaller.
2. Install bronze connectors for non-domestic water copper equipment connections 2” and smaller.
3. Install flanged stainless steel connectors for flanged equipment connections 2-1/2” and larger.

B. Install connectors according to manufacturer’s recommendations.

3.9 PIPE FIELD QUALITY CONTROL

A. Testing: Refer to individual piping system specification sections.

B. Inspection Report Form: Refer to the inspection report form at the end of this section for inspection data to be completed for each piping system. Submit completed forms to the Owner and Engineer.

END OF SECTION 220515

PLUMBING & PLUMBING PIPING SYSTEMS
INSPECTION REPORT FORM

Project Name:
Project No: _____ Contractor Project No. _____
General Contractor: _____
Inspection Date: _____Temperature: _____

System Inspected

Building: _____
Location/Description: _____
Service: _____

Inspection Results

Time of Inspection: _____
Approval to Insulate: Y N Approval to Cover in Wall: Y N
Approval to backfill Y N

Signatures

Witness: _____ Representing: _____
Witness: _____ Representing: _____
Witness: _____ Representing: _____

Remarks

_____
_____
_____
Contractor Supervisor's signature: _____

SECTION 220523 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes general duty valves common to most plumbing water distribution piping systems.

1. Special purpose valves are specified in individual piping system specifications.

1.2 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

B. Submit certification that valves for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Provide products specified in this section from the same manufacturer where products are available and conform to the specification requirements.

B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:

1. MSS SP 67 “Butterfly Valves”
2. MSS SP 70 “Gray Iron Gate Valves, Flanged and Threaded Ends”
3. MSS SP 71 “Gray Iron Swing Check Valves, Flanged and Threaded Ends”

4. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
5. MSS SP 80 “Bronze Gate, Globe, Angle and Check Valves”
6. MSS SP 85 “Gray Iron Globe and Angle Valves, Flanged and Threaded Ends”
7. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”
8. MSS SP 125 “Check Valves: Gray Iron and Ductile Iron, In-Line, Spring Loaded, Center-Guided”
9. MSS SP 139 “Copper Alloy Gate, Globe, Angle and Check Valves for Low Pressure/Low Temperature Plumbing Applications”

D. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves containing no more than 0.25% lead by weight compliance for valves for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.2 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems.

1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:

1. Handwheels, fastened to valve stem, for valves other than quarter turn.
2. Lever handles, on quarter-turn valves 6-inch and smaller.
3. Chain-wheel operators, for valves 2-1/2-inch and larger, installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
4. Gear drive operators, on quarter-turn valves 8-inch and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. End Connections: As indicated in the valve specifications.

1. Threads: Comply with ANSI B1.20.1.
2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

3. Solder-Joint: Comply with ANSI B16.18.

a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

A. Gate Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body, solid wedge and bonnet of ASTM B 584 lead free cast bronze; brass packing gland and stem of ASTM B283 naval brass; with solder ends, non-asbestos composition packing, and malleable iron handwheel.

2.4 BALL VALVES

A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, regular port, blowout-proof stem and chrome-plated lead free brass ballwith replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2” and larger: Meeting MSS SP 72, 200 CWP, lead free, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, FDA epoxy coating, PTFE gasket, stem seal and seat.

2.5 GLOBE VALVES

A. Globe Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 300-psi CWP; body, disc and screwed bonnet of ASTM B 584 lead free cast bronze; brass replaceable composition disc and stem of ASTM B 283 alloy C46400 naval brass, brass packing gland, with solder ends, non-asbestos composition packing, and malleable iron handwheel.

2.6 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body and cap of ASTM B 584 cast lead free bronze; with horizontal swing, Y-pattern, disc and disc holder of ASTM B 283 alloy C46400 naval brass; solder ends. Provide valves capable of being reground while the valve remains in the line.

B. Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-139; 250-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.

PART 3 - EXECUTION

3.1 INSTALLATIONS

A. Install valves in accordance with manufacturer’s installation instructions.

B. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.

G. Installation of Check Valves: Install for proper direction of flow as follows:

H. Swing Check Valves: Horizontal position with hinge pin level.

3.2 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-Inch and Smaller: Solder ends.
2. Copper Tube Sizes 2-1/2 Inch and Larger: flanged end.

3.3 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. Domestic Hot and Cold Water Service

VALVE TYPE	2" AND SMALLER	2-1/2" AND LARGER
Ball	150	200
Butterfly	N/A	200
Gate	125	125
Globe	125	125
Check	125	125

3.4 VALVE SCHEDULE

A. Gate Valves - 2 inch and smaller:

MANUFACTURER	SOLDER NRS
Apollo	102S-LF
Hammond	UP-668
Milwaukee	UP668
NIBCO	S-113-LF

B. Ball Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS
Apollo (Conbraco)	70-LF-200
Hammond	UP8511
Milwaukee	UPBA-150
NIBCO	N/A

C. Globe Valves - 2-1/2 inch and larger:

MANUFACTURER	STRAIGHT BODY	ANGLE BODY
Apollo	711F-LF	N/A

D. Globe Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS
Apollo	120S-LF
Hammond	UP-418
Milwaukee	UP1502
NIBCO	S113

E. Swing Check Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Apollo	161S-LF	161T-LF
Milwaukee	UP1509	UP509
NIBCO	S-413-Y-LF	T-413-Y-LF

F. Swing Check Valves - 2-1/2 inch and larger:

MANUFACTURER	CLASS 125	CLASS 175
Apollo	910F-LFA	x
Milwaukee	F2974A26	x

1. x means not available.

G. Wafer Check Valves – Class 125:

MANUFACTURER	MODEL
Hammond	IR9253
Metraflex	CVOSS
Milwaukee	1400
NIBCO	W910-B-LF

H. Wafer Check Valves – Class 250:

MANUFACTURER	MODEL
Metraflex	CVOSS

I. Lift Check Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Hammond	UP947	UP943
Milwaukee	UP1548T	UP548T
NIBCO	S-480-Y-LF	T-480-Y-LF

3.5 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:

1. Gate Valves, 2” and smaller: Class 125, with cast bronze body.
2. Gate Valves, 2-1/2”: Class 125 with cast-iron body.

3. Ball Valves, 2” and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe.,.
4. Ball Valves, 2-1/2” and larger: 200-psi CWP cast iron body.

5. Globe Valves, 2” and smaller: Class 125, with cast bronze body and bronze or teflon disc.
6. Globe Valves, 2-1/2” and larger: Class 125, with cast iron body and bronze or teflon disc.

7. Butterfly Valves, 2-1/2” and larger200-psi working pressure with cast or ductile iron body

8. Swing Check, 2-1/2” and smaller: Class 125, cast bronze, with rubber seat.

9. Check Valves, 2-1/2” and larger: Class 125, swing or wafer type as indicated.

3.6 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.7 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following:

1. Horizontal-piping hangers and supports.
2. Vertical-piping clamps.
3. Saddles and Shields.
4. Hanger-rod attachments.
5. Building attachments.
6. Spring hangers and supports.
7. Pre-engineered support strut systems

8. Pipe alignment guides.
9. Anchors.
10. Expansion Anchors.
11. Equipment supports.

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

1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
2. Division 22 “Water Distribution Piping and Specialties”, for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
3. Division 22 “Sanitary Drainage & Vent Piping and Specialties”, for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.
4. Division 22 “Storm Drainage & Piping and Specialties”, for pipe hanger types and spacing for horizontal and vertical storm drainage piping of sizes and materials indicated.

1.2 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

1.3 SUBMITTALS

A. General: Submit the following in accordance with conditions of contract and Division 01 specification Sections.

1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
2. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
3. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
4. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
5. Maintenance data for supports and anchors for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
6. Submit style and type of anchors to Architect or Structural Engineer for approval prior to installation.

1.4 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. Regulatory Requirements: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.

D. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Hangers, supports, and components shall be listed and labeled by a NRTL where used for fire protection piping systems. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Hangers and Supports

1. Armacell.
2. Anvil International.
3. B-Line.
4. Elite Components
5. Halfen-DEHA.

6. Hilti.
7. ERICO\Michigan Hanger Co..
8. FNW
9. Midwest.
10. National Pipe Hanger Corporation.
11. Power-Strut.
12. Truscon.
13. Unistrut.

B. Pre-Insulated Supports:

1. Calcium Silicate Shield Supports:

a. Cooper B-Line, Inc.
b. Buckaroos, Inc.

2. Pre-Engineered Thermal Hanger Inserts:

a. Armacell “Armafix”.
b. Cooper B-Line, Inc.

C. Expansion Anchors:

1. Hilti.
2. Phillips.
3. Power Fasteners.

2.2 SUPPORT MATERIALS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

3. Components as listed below shall be made of 304 stainless steel where indicated.

2.3 SADDLES AND SHIELDS

A. Pipe Covering Protection Saddles:

1. Sheet metal construction, meeting MSS SP-58 Type 39A or B, 100-psi average compressive strength, with center rib for pipes 12” and larger. Saddles shall cover approximately one sixth of the circumference of the pipe and shall be 12” long.

B. Pre-Insulated Supports:

1. Calcium Silicate Shield Supports:

a. Waterproofed calcium silicate conforming to ASTM C795 encased with an insulation protection shield.

2. Pre-Engineered Thermal Hanger Inserts:

a. Flexible elastomeric insulation conforming to ASTM C534, Type I with integral high density pipe support.

C. Insulation Protection Shield:

1. Sheet metal construction, meeting MSS SP-69 & SP-58 Type 40, of 18 gauge for 5-1/2" inside dimension and smaller, 16 gauge for 6-1/2" to 10-3/4" inside dimension 14 gauge for 11-3/4" to 17" inside dimension, and 12 gauge for 18" to 28" inside dimension. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

a. Length: Minimum 8 inch long section at each support joint.
b. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in) Hanger Spacing, (ft) 5	6	7	8	9	10
	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
≤ 1	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
≤ 2	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

2. 360° Insulation Protection Shield: Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

D. Hangers with pre-manufactured polymer inserts:

1. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally may be used in lieu of other

insulated pipe support systems. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Note: Metal shields are not required with clevis hangers of this type. Approved manufacturers include:

a. Klo-Shure.
b. Anvil.
c. Holdrite.

2.4 PRE-ENGINEERED SUPPORT STRUT SYSTEMS

A. Support strut systems shall comply with MSS SP-69, Type 59. Shop- or field-fabricated pipe-support assembly shall be made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts. Minimum 14 gauge galvanized steel with factory-punched attachment holes. Two piece straps shall be captivated at the shoulder when attachment nut is tightened and designed for use with strut system. Long or short pipe rollers designed for use with strut system, where indicated, shall attach to the channel with brackets and nuts. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated. All nuts, brackets and clamps shall have the same finish as the channels.

2.5 PIPE ALIGNMENT GUIDES

A. Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.6 EXPANSION ANCHORS

A. Self drilling, drilled flush or shell type.

2.7 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: Conforming to ASTM A 36.

B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install hangers and supports in accordance with manufacturer's installation instructions.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure.

B. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.

C. Hanger and clamps sizing:

1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
4. Refer to Section 220700 for definition of hot and cold piping and required insulation thickness.

D. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.

G. Field-Fabricated, Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.

H. Support fire protection systems piping independently from other piping systems.

I. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

J. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.

L. Insulated Piping: Comply with the following installation requirements.

1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with riser clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section “Plumbing Insulation”.
2. Pipe Covering Protection Saddles: Install pipe covering protection saddles where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Insulation Protection Shield: Install insulation protection shield and high density insulation where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section “Plumbing Insulation”.

    a. Exception for horizontal cold piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified for pipe size and insulation thickness to prevent puncture or other damage as specified in Division 22 Section “Hangers and Supports for Plumbing Piping and Equipment.”

4. Contractor’s Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inch and larger.
5. Contractor’s Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.

M. Pre-engineered Support Strut Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer’s recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer’s recommendations.

1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
2. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section “Plumbing Insulation”.

N. Expansion Anchors: Use in existing concrete, masonry or in pre-cast concrete construction.

O. Pre-Engineered Roof Pipe Supports: Set supports on an 18" X 18" x 3/16" thick roof walkway material compatible with the roof material.

3.3 INSTALLATION OF PIPE ALIGNMENT GUIDES

A. Install pipe alignment guides on piping that adjoins expansion joints, as required by expansion joint manufacturer, and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Install guides per ASME B31.9 unless noted otherwise.

B. Anchor to building substrate.

3.4 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.

D. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.5 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for piping and equipment.

3.6 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.7 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of Plumbing insulation required by this Section is indicated on drawings and schedules, and by requirements of this Section.

B. Types of Plumbing insulation specified in this Section include the following:

1. Piping Systems Insulation:

a. Fiberglass

b. Flexible Elastomeric

1.2 QUALITY ASSURANCE

A. Flame/Smoke Ratings: Provide composite Plumbing insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E 84 (NFPA 255) method.

1. Exception: Outdoor Plumbing insulation may have flame spread index of 75 and smoke developed index of 150.
2. Exception: Industrial Plumbing insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

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

1. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields for protecting insulation vapor barrier and materials and methods for piping installations.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of Plumbing insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each Plumbing system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of Plumbing insulation. Include this data and product data in maintenance manual.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

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

1. CertainTeed Corp.
2. Knauf Insulation
3. Johns Manville
4. Owens Corning

2.2 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.

B. Flexible Elastomeric Piping Insulation: ASTM C534, Type I.

C. Jackets for Piping Insulation: ASTM C1136, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

1. PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, Johns Manville Zeston 2000 PVC or approved equivalent. Factory supplied, pre-cut insulation blanket inserts for use with PVC fitting covers are acceptable.

D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

F. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.

G. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.

H. High Density Insulation Billets:

1. Cellular Glass: ASTM C552.

2.3 EQUIPMENT INSULATION MATERIALS

A. Rigid Fiberglass Equipment Insulation: ASTM C612, Class 2.

B. Flexible Fiberglass Equipment Insulation: ASTM C553, Type I, Class B-4.

C. Flexible Elastomeric Equipment Insulation: ASTM C534, TYPE II.

D. Jacketing Material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.

E. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

F. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s installation instructions.

3.2 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on the following:

1. Chrome-plated exposed piping
2. Water Hammer Arrestors
3. Balancing and flow valves
4. Drain lines from water coolers
5. Drainage piping located in crawl spaces or tunnels
6. Exterior condensate drain piping
7. Buried piping
8. Pre-insulated equipment.

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:

a. Potable cold water piping.
b. Non-potable cold water piping
c. Potable chilled water piping.
d. Plumbing vents within 6 lineal feet of roof outlet.
e. Horizontal interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.

f. Horizontal and vertical interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
g. Horizontal and vertical interior above-ground overflow storm drainage piping and vertical run from roof drain to horizontal run. Where vertical overflow storm drainage piping from the outlet exceeds 15 feet, only insulate within 15 feet of the outlet.
h. Lawn irrigation piping.
i. Condensate piping inside the building.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 1" thickness.

C. Piping Inside Masonry Wall Units:

1. Insulate cold, hot and hot water recirculation piping installed inside of masonry walls where the piping needs to be insulated as the wall is constructed as described below:

a. Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1" thick for pipe sizes 2" to 6" (largest size permitted).

D. Exterior piping:

1. Encase exterior piping insulation with aluminum weather-proof jackets.
2. Insulate exterior cold water, hot water, hot water recirculation and non-potable water piping as previously described.
3. Insulate and heat trace exterior [sanitary p-traps,] [sanitary,] [grease waste,] [storm,] and [overflow storm] piping as described below. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.

a. Fiberglass: 1" thickness.
b. Flexible Elastomeric: 1" thickness.

E. Interior piping with heat trace:

1. Insulate and heat trace grease waste piping and grease waste P-traps as described below. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.

a. Fiberglass: 2" thickness.
b. [Calcium Silicate: 2-1/2" thickness.]
c. Flexible Elastomeric: 2" thickness.

3.3 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Maintain continuous thermal and vapor-retarder integrity throughout entire installation unless otherwise indicated.

C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

E. Clean and dry pipe surfaces prior to insulating.

F. Cold Pipe Insulation:

1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section “Hangers and Supports for Plumbing Piping” for pre-insulated supports.
3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section “Hangers & Supports for Plumbing Piping” for insulation shields.
4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.

G. Pipe insulation:

1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section “Hangers and Supports for Plumbing Piping” for pre-insulated supports.
3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section “Hangers & Supports for Plumbing Piping” for insulation shields.
4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints.
6. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints.

7. For cold pipes, apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.

H. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves (except balancing and flow control valves), strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Butt tightly against adjoining pieces and bond with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves (except balancing and flow control valves), flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

I. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on

insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

J. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

K. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

3.4 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 221100 - WATER DISTRIBUTION PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.

B. Contractors Option:

1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined water distribution piping systems where used shall be provided in compliance with specification Section 221111 “Mechanically Joined Plumbing Piping Systems”.

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

1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 2 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building.
3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
4. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
5. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges and mechanical sleeve seals.
6. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
7. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials and methods for hanging and supporting water distribution piping.
8. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.
9. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties,” for material and methods for trap primer outlet piping.

1.2 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.

C. Pipe sizes used in this Specification are nominal pipe size (NPS).

D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

1. Product data for each piping specialty and valve specified.

2. Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Article "Quality Assurance" below.
3. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
4. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
5. Test reports specified in Part 3 of this Section.

6. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:

    a. Hose bibbs
    b. Wall, yard and roof hydrants
    c. Backflow preventers isolating irrigation or mechanical make-up systems
    d. Emergency mixing valves
    e. Trap primers

1.4 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

B. Regulatory Requirements: Comply with the provisions of the following codes:

1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.

C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.

D. Pipe, fittings and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

1.5 SPARE PARTS

A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

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

1. Hose Bibbs with Vacuum Breaker:

   a. Chicago Faucet Co.
   b. Eljer, A Household International Company
   c. T & S Brass & Bronze Works, Inc.

2. Hose Bibbs:

   a. Lee Brass Co.
   b. Mansfield Plumbing Products
   c. Nibco, Inc.
   d. Prier, Inc.
   e. Watts Regulator Co.
   f. Woodford Mfg. Co.
   a. [Mifab Manufacturing, Inc.]

3. Wall/Yard Hydrants:

   a. Josam Co.
   b. Smith (Jay R.) Mfg. Co.
   c. Prier, Inc.
   d. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.

e. Watts Drainage
f. Woodford Mfg. Co.
g. Zurn Industries Inc., Hydromechanics Div.
b. Mifab Manufacturing, Inc.

4. Piston Type Water Hammer Arresters:

a. Amtrol, Inc.
b. Josam Co.
c. Precision Plumbing Products, Inc.
d. PROFLO
e. Sioux Chief Manufacturing Co.
f. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
g. Watts Regulator Co.
h. Zurn Industries, Inc. Wilkins Regulator Div.

5. Plumbing Pipe Support Brackets

a. Holdrite
b. PROFLO
c. Sioux Chief

6. Tube Suspension Clamps

a. PROFLO
b. Sioux Chief or approved Equivalent

2.2 PIPE AND TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or “Below Ground Water Distribution Pipe and Fittings”, for identification of systems where the materials listed below are used.

B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.

C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.

D. Steel Pipe: ASTM A53, Type E or S, schedule 40, Grade B, galvanized, threaded ends.

E. Ductile-Iron Pipe: AWWA C151 or AWWA C115 ductile-iron pipe, with AWWA C104 cement-mortar lining.

F. PVC Plastic Service Pipe: AWWA C900, Class 100 Polyvinyl Chloride (PVC) water pipe, with belled-end fittings.

G. Brass Pipe: Chrome Plated Schedule 40 ASTM B43 iron pipe size (IPS.)

2.3 FITTINGS

A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.

B. Galvanized Malleable Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.

C. Ductile-Iron Gasketed Fittings: AWWA C110 or AWWA C153, 150 psi rating, with cement mortar lining and AWWA C111 rubber gaskets.

D. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.

E. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.

F. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.

G. PVC to Ductile Iron Adapter Flanges: EBBA Iron, Inc. Series 2000PV or approved equivalent.

2.4 JOINING MATERIALS

A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.

B. Brazing Filler Metals: AWS A5.8, BAg Silver.

C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.5 GENERAL-DUTY VALVES

A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.

2.6 SPECIAL DUTY VALVES

A. Flow Control Valves: 400 psi WOG, 1 piece bronze, ball valve, with lead free cast bronze body meeting ASTM B584, handle, memory stop, with solder-end connections.

B. Automatic Flow Control Valves: 400 PSI WOG, flow regulator, with series 300 stainless steel body, series 300 stainless steel automatic pre-set flow balancing cartridge, union connection body, and threaded-end connections.

2.7 PIPING SPECIALTIES

A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.

B. Hose Bibbs: Bronze body, renewable composition disc, tee handle, 1/2- or 3/4-inch solder inlet, hose outlet.

C. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.

D. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, integral vacuum breaker, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.

E. Recessed Nonfreeze Wall Hydrants: Cast-bronze box, with chrome-plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.

F. Projecting Nonfreeze Wall Hydrants: Cast-bronze, with chrome-plated face, tee handle key, vacuum breaker, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.

G. Nonfreeze Yard Hydrants: Cast-bronze hydrant, with rough bronze box, tee-handle key, drain hole, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit depth of bury.

H. Nonfreeze Post Hydrants: Cast-bronze hydrant, with tee-handle key, drain hole, vacuum breaker, 3/4-inch inlet, and hose outlet. Bronze casing with cast-iron casing guard shall be length to suit depth of bury.

I. Piston Type Water Hammer Arresters: Piston type, with casing of type “L” copper tube and spun copper ends, nylon piston with two EPDM “O”rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.

J. Bellows Type Water Hammer Arresters: Bellows type, with 304 stainless steel casing construction, threaded pipe connection, precharged upper chamber, sealed in stainless steel diaphragm, maximum working pressure of 150 psi, maximum shock pressure of 300 psi, tested and certified in accordance with PDI Standard WH-201.

K. Pipe Support Brackets:

1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of ½” on 2” centers and holes of ¾” or 1” on 4” centers.
2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.

3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.

L. Tube Suspension Clamps

1. Combination plastic supports and insulators for installing copper tube in stud walls with integral bracket for securing to stud with screws.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

3.2 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 8 inches and smaller, within the building.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

I. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section “Common Work Results for Plumbing” for special sealers and materials.

J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.

K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.

L. Install piping with 1/32-inch-per-foot (1/4 percent) downward slope towards drain point.

1. Install piping level with no pitch.

3.4 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping”. Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:

1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.
3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections “Supports and Anchors” and “Plumbing Insulation”.
4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2” and smaller on walls and for securing 1-1/4” to 2” copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.

    a. Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section “Plumbing Insulation” for requirement for maintenance of the vapor barrier and vapor barrier seal method.

5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2” and smaller on walls or for securing tube inside walls for connection to faucets.
6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.

7. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.

8. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste & vent pipe at each plumbing fixture.
9. Secure 1" and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.

    a. Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.
    b. Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.

10. Secure copper tubes for flush valve wall mounted water closets to the chair carrier with carrier brackets.

C. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1-1/4	7	7	3/8
1-1/2	9	8	3/8
2	10	8	3/8

1. Support vertical steel pipe at each floor.
2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.
3. Support plastic pipe and tubing in accordance with manufacturer's recommendations.

D. Support water piping within 12" of each elbow or tee and for water piping 2-1/2" and larger at each valve or strainer.

E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
3. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

E. Joints Containing Dissimilar Metals: Provide dielectric unions for 2” and smaller and dielectric flanges for piping 2-1/2” and larger. Provide dielectric waterway fittings for 2” and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section “Basic Piping Materials and Methods”.

F. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section “Basic Piping Materials and Methods”.

3.6 VALVE APPLICATIONS

A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shut-off duty: Use gate, ball, and butterfly valves.

B. Throttling duty: Use globe, ball, and butterfly valves.

3.7 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate or ball valves; for sectional valves 2-1/2 inches and larger, use ball, gate or butterfly valves.

B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use ball, gate or butterfly valves.

C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves; for drain valves 2-1/2 inches and larger, use ball, gate or butterfly valves.

1. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.

D. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.

E. Wall Hydrants: Install where indicated with vacuum breaker.

3.8 INSTALLATION OF PIPING SPECIALTIES

A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.

B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.9 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

    a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
    c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
    d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.

B. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

C.

3.10 ADJUSTING AND CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.

2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:

    a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
    c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
    d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
    e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

3.11 COMMISSIONING

A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.

B. Before operating the system, perform these steps:

    1. Close drain valve, hydrants, and hose bibbs.
    2. Open valves to full open position.

END OF SECTION

SECTION 221300 - SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.

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

1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 33 Section "Sanitary Sewage Systems," for sanitary drainage piping beginning from 5'-0" outside the building.
3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
4. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.
5. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
6. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
7. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
8. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
9. Division 22 Section “Water Distribution Piping and Specialties,” for material and methods for trap primers and trap primer inlet piping.

1.2 DEFINITIONS

A. Sanitary Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste and other drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Sanitary Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

B. Product data for the following products:

1. Drainage piping
2. Drainage piping specialties
3. Floor drains

C. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:

1. 2015 International Plumbing Code

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

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

1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, floor drains, cast-iron trench drains and vandal-proof vent caps:

a. Josam Mfg. Co.
b. Sioux Chief Manufacturing Co. Inc.
c. Jay R. Smith Mfg. Co.
d. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
e. Watts Industries, Inc.
f. Zurn Industries, Inc.; Hydromechanics Div.
g. Mifab Manufacturing Co.

2. Freeze-proof vent caps:

a. F.J. Moore Mfg. Co.

3. Cast Iron Soil Pipe and Fittings

a. AB & I Foundry
b. Charlotte Pipe and Foundry Company
c. Tyler Pipe / Soil Pipe Division

4. Shielded Transition Couplings

a. FERNCO, “Proflex 3000 Series”
b. Mission Rubber Company, “Band Seal Specialty Couplings”

5. Underground Shielded Adapter Couplings

a. FERNCO, “1056 Series with SR73 Shear Ring”
b. Mission Rubber Company, “MR56 Series”

6. Trap Seals

a. Jay R. Smith Mfg. Co.
b. Mifab Manufacturing, Inc.Proset Systems “Trap Guard”
c. Sure Seal, Inc.
d. Zurn Industries, Inc.; Hydromechanics Div.

7. Hubless Couplings:

a. Anaco
b. Ideal Tridon
c. Mission Rubber Company
d. ProFlo “PFNH”
e. Tyler Pipe / Soil Pipe Division

8. Heavy Duty Hubless Couplings for Below Slab

a. Anaco Husky HD-4000
b. Clamp-All 125in. lb.

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

A. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, no-hub pipe and fittings and bearing the trademark of CISPI and NSF.

1. Couplings and compression gaskets, NSF certified: ASTM C564 and CISPI 310.

2. Heavy duty couplings and compression gaskets: ASTM C1540 and meeting FM 1680.

B. Copper Tube: ASTM B306, Type DWV, hard drawn for pipe, and cast copper alloy solder joint drainage fittings (DWV) meeting ASME / ANSI B16.23.

1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.

C. Copper Tube: ASTM B88, Type M, hard drawn for pipe and wrought copper fittings with soldered joints.

1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.

D. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.

1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
2. Solvent: ASTM D2564.

E. PVC Pressure Pipe and Fittings: Schedule 80 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.

1. Solvent: ASTM D2564.
2. Fittings: Schedule 80 meeting ASTM D2467 with solvent cement socket joints.

F. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.3 UNDERGROUND BUILDING DRAIN AND VENT PIPE AND FITTINGS

A. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces and bearing the trademark of CISPI and NSF.

1. Neoprene Compression Gaskets: ASTM C564.

B. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.

1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
2. Solvent: ASTM D2564.

C. PVC Pressure Pipe and Fittings: Schedule 80 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.

1. Solvent: ASTM D2564.
2. Fittings: Schedule 80 meeting ASTM D2467 with solvent cement socket joints.

D. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.4 DRAINAGE PIPING SPECIALTIES

A. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.

B. Cleanout Plugs: As specified on the drawings.

C. Floor Cleanouts: As specified on the drawings.

D. Wall Cleanouts: As specified on the drawings.

E. Floor Drains: As specified on the drawings.

F. Trap seals: Provide trap seals meeting either description below:

1. Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The flow of wastewater allows duck's bill to open and adequately discharge to floor drain through its interior. The duck's bill closes and returns to original molded shape after wastewater discharge is complete. Or, smooth, soft, flexible, elastomeric PVC material with a flapper closure. The flow of wastewater allows flapper to open and adequately discharge to floor drain through its interior. The flapper closes and returns to original molded shape after wastewater discharge is complete.

2.5 PVC DWV EXPANSION JOINTS

A. Schedule 40 PVC DWV meeting ASTM D2665 with socket connections and telescoping expansion joint with EPDM O-ring seal.

2.6 NO-HUB FITTING RESTRAINTS

A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR UNDERGROUND SANITARY BUILDING DRAINS

A. Pipe Beds:

1. PVC and ABS Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer

to ASTM D2321 “Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications” for additional requirements.

2. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6” underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section ”General Plumbing Requirements” for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

A. Install hubless, cast-iron soil pipe and fittings for 15” and smaller soil, waste, and vent pipe.

B. As a contractor’s option with Owner approval, install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe, except install no plastic pipe in return air plenums.

3.4 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller for soil, waste, and vent pipe.

B. As a contractor’s option with Owner approval, install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe for 24” and smaller. Install fabricated fittings for 16 inch and larger.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."

B. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:

1. Install hubless couplings complying with CISPI 310 on soil, waste and vent piping.
2. Install hubless couplings complying with CISPI 310 on and soil and waste piping 3” and smaller and all vent piping.
3. Install heavy duty hubless couplings on soil or waste stacks, soil and waste piping connections to soil or waste stacks and all soil and waste piping 4” and larger.
4. Install No-Hub fitting restraints on joints 5” and larger at:

    a. Changes of direction from vertical to horizontal

b. 4” branch connections, including tees, wyes and wye combination fittings to soil and waste piping 5” and larger
c. Horizontal changes of direction 22-1/2 degrees and greater

C. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.

D. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.

E. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.

F. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

3.6 INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Paint exposed copper drain lines serving kitchen equipment with a minimum of two coats of chromium-base paint.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section " Basic Piping Material and Methods” for special sealers and materials.

I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section “Basic Piping Material and Methods” for additional information.

J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section " Basic Piping Material and Methods” for special sealers and materials.

K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.

L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing” for special sealers and materials.

M. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Double wyes or double wye combinations shall not be used in the horizontal. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

N. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

O. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.

P. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Sewer service piping is specified in a separate section of Division 2.

Q. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

3.7 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.

3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".

   a. Install high density insulation on insulated pipe.

4. Provide vinyl coated hangers and riser clamps for use with PVC pipe.

C. Install hangers at the following intervals and provide rods of diameter as listed below:

Nom. Pipe Size In Inches	Steel Pipe Max. Span In Feet	Copper Tube Max. Span. In Feet	Min. Rod Dia. - Inches Steel or Cast Iron	Min. Rod Dia. – Inches Copper or PVC
Up to 3/4	7	5	3/8	3/8
1	7	6	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	9	8	3/8	3/8
2	10	8	3/8	3/8
2-1/2	11	9	1/2	3/8
3	12	10	1/2	1/2
3-1/2	13	11	1/2	1/2
4	14	12	5/8	1/2
5	16	13	5/8	1/2
6	17	14	3/4	5/8
8	19	16	7/8	3/4
10	22	18	7/8	3/4
12	23	19	7/8	3/4

1. Support all sizes of service weight horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide sway brace on horizontal piping at not more than 40' intervals to prevent horizontal movement. Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of horizontal of PVC piping every four feet.
4. Support all sizes of vertical of PVC piping every floor, but not to exceed fifteen feet.
5. Support piping within 12" of each elbow or tee.
6. Support each P-trap.

3.8 INSTALLATION OF PIPING SPECIALTIES

A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.

B. Provide PVC DWV expansion joints every 30' on straight vertical PVC waste or sanitary stacks receiving hot water waste. Install expansion joint at middle travel for equal expansion and contraction travel. Provide riser clamps within 18" of each end of expansion joint. Install expansion joint per manufacturer's installation instructions.

C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
4. at base of each vertical soil and waste stack.

D. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.

E. Floor Cleanouts: Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping.

1. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

G. Frost-Proof Vent Caps: Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1 inch clearance between vent pipe and roof substrate.

3.9 INSTALLATION OF FLOOR DRAINS, FLOOR SINKS AND FLOOR TROUGHS

A. Install floor drains, floor sinks, shower linear trench drains and floor troughs in locations indicated.

B. Install floor drains, trench drains and shower linear trench drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.

C. Refer to architectural documents for floor slope requirements and set floor drain elevation to match. Where architectural documents do not indicate the requirements, set the floor drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

DEPRESSION IN INCHES	RADIUS OF AREA DRAINED - FEET
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

D. Provide P-traps for drains connected to the sanitary sewer.

E. Install floor drains, floor sinks, shower linear trench drains, and floor troughs in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Position drains so that they are level, accessible and easy to maintain.

3.10 INSTALLATION OF TRAP PRIMERS

A. Install trap primer outlet piping with 1/32” per foot slope towards drain trap where possible.

B. Connect trap primer outlet piping only to factory installed taps on the drain body or P-trap assembly or provide an auxiliary inlet fitting with factory installed trap primer tap.

C. Install trap primer outlet piping in elevated slabs or slabs on grade below concrete reinforcing bars. Wrap with ½” thick flexible unicellular insulation, attach to the reinforcing bars with plastic ties and spacers every five feet to eliminate galvanic corrosion. Refer to Division 22 Section "Plumbing Insulation” for flexible unicellular insulation.

D. Where proper trap primer outlet piping slope can be maintained and the trap primer outlet line would not be subject to freezing, trap primer outlet lines may be installed as follows:

1. Install below elevated floor slabs.
2. Install in the sub grade of slab on grade.

E. Install sleeves and caulk at penetrations through building floor for watertight installation. In an elevated floor slab installation, bracket the piping to bottom of floor once the slab is poured.

F. Refer to Division 22 Section “Water Distribution Piping and Specialties” for trap primer and trap primer inlet pipe requirements.

3.11 INSTALLATION TRAP SEALS:

A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.

B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.

C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.

D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

3.12 CONNECTIONS

A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.

B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.13 FIELD QUALITY CONTROL

A. Inspections

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
d. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
4. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Tightly close all openings, initially except vents thru the roof, in the system and fill the system with smoke from one or more smoke machines designed for smoke testing of plumbing systems. When smoke appears at a vent thru the roof, seal the vent thru roof with a test plug. Pressurize the system with 1” water column of smoke for 15 minutes. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Visually verify all joints for leaks.
5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.14 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.15 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

SECTION 227000 - NATURAL GAS SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:

1. Pipes, fittings, and specialties.
2. Special duty valves.
3. Pressure regulators.

B. Contractors Option:

1. The Division 22 contractor may provide mechanically joined joints for natural gas systems to connect couplings, fittings, valves and related components as an option in lieu of, in whole or in part, welded, threaded or flanged piping methods. Mechanically joined natural gas systems where used shall be provided in compliance with specification Section 227011 “Mechanically Joined Natural Gas Systems”.

C. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

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

1. Division 22 Section "General plumbing Requirements," for trenching, excavation, backfill and compaction materials and methods for underground piping installations.
2. Division 9 Section "Painting," for materials and methods for painting pipe.
3. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall and floor penetrations.
4. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, unions, dielectric flanges and mechanical sleeve seals.
5. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting gas distribution piping.
6. Division 26 Section “Common Work Results for Electrical” required electrical devices.

E. Gas pressures for systems specified in this Section are limited to 5 psig.

1.2 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.

C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.

D. Point of Delivery: The outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.3 SUBMITTALS

A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Shop drawings detailing dimensions, required clearances, for connections to gas meter.

C. Coordination drawings for gas distribution piping systems in accordance with Division 22 Section "General Plumbing Requirements."

D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

E. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.

F. Test reports specified in Part 3 below.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."

C. Regulatory Requirements: Comply with the requirements of the following codes:

1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installation and inspections, testing, and purging of gas piping systems.

2. 2015 International Fuel Gas Code

D. Local Gas Utility Requirements: Comply with local gas utility installation rules and regulations.

E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

1.5 SPARE PARTS

A. Valve Wrenches: Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:

1. Gas Ball Valves – 2” and Smaller:

a. Apollo Valves # 77F-1XX-01
b. Hammond Valve # 8901
c. Milwaukee Valve # BA-475B
d. Nibco Inc. # T-FP 600A
e. Watts # FBV-3C

2. Gas Cocks – 2” and Smaller:

a. Homestead # 601
b. Milliken #200M
c. RM Energy Systems # D125

3. Gas Pressure Regulators

a. American Meter Company
b. Fisher
c. Itron

d. Sensus
e. Maxitrol

4. CSA Listed Gas Pressure Regulators

a. Karl Dungs, Inc.
b. Maxitrol
c. Pietro-Fiorentini

5. Pre-sleeved Vent Capable Semi-rigid Corrugated Stainless Steel Tubing

a. Omegaflex, Inc. TracPipe II

6. Polyethylene Pipe and Pipe Fittings:

a. Cresline Plastic Pipe Co. PE 2708
b. Charter Plastics PE 2708
c. Chevron Phillips DriscoPlex Series 6500

7. Polyethylene to Steel Pipe Transition Fittings:

a. Perfection Corporation
b. R.W. Lyall
c. Central Plastics

8. Insect Screens

a. Northtown Pipe Protection Products “BUGSCRN Series”

9. Gas Relief Vents

a. Richards “GV Series”

2.2 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the specified pipe and fitting materials listed below are used.

B. Steel Pipe: ASTM A 53, Grade B, Schedule 40, (Type E electric-resistance welded or Type S seamless, black steel pipe, beveled ends).

C. Copper Tubing - Drawn Temper: ASTM B88, Type L.

D. Semi-rigid Corrugated Stainless Steel Tubing: Type 304 stainless tubing meeting ASTM A240, with UV resistant polyethylene jacket meeting ASTM E-84 flame and smoke rating and yellow brass auto-flare ends with stainless steel inserts.

E. Pre-sleeved Vent Capable Semi-rigid Corrugated Stainless Steel Tubing: Type 304 stainless tubing meeting ASTM A240, with UV resistant polyethylene jacket meeting ASTM E-84 flame and smoke rating, encased in a polyethylene ventable sleeve and yellow brass auto-flare ends with stainless steel inserts.

F. Plastic Pipe: Medium Density, SDR-11 iron pipe size polyethylene pipe, meeting ASTM D 2513, with heat fusion connections. Pipe shall meet Plastic Pipe Institute Material Designation of PE 2708.

2.3 FITTINGS

A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

1. 1-1/4” and smaller shall be socket type
2. 1-1/2” and larger shall be butt weld type.

C. Forged Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, butt weld ends, standard pattern with bolts, nuts and gaskets of material group 1.1.

D. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

E. Plastic Fittings: Medium density polyethylene socket fusion fittings, meeting ASTM D 2515 compatible with the piping system.

F. Transition Fittings – Steel to Polyethylene: Factory assembled and pressure tested one piece design, with steel half of Schedule 40 steel pipe with beveled edge for welding and polyethylene half shall be of ample length for making welds. Steel pipe shall have epoxy protective coating.

G. Insect screens: Black steel body with 20 mesh stainless steel screen and MNPT end.

H. Gas Relief Vents: Galvanized steel body with 90 degree inlet to screened outlet, 20 mesh stainless steel screen and FNPT end.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

B. Joint Compound: Suitable for the gas being handled.

C. Gasket Material: Thickness, material, and type suitable for gas to be handled, and for design temperatures and pressures.

2.5 PIPING SPECIALTIES

A. Seismic Gas Valves: Sinking ball or swing type for vertical or horizontal installation, UL listed, tested to ASCE 25-97 and ANSI Z71.70 with iron body, site gauge, threaded ends for 2 inch and smaller, flanged ends for 2-1/2" inch and larger with a 60 psig maximum operating pressure.

B. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:

1. overall thickness; 20 mils;
2. synthetic adhesive;
3. water vapor transmission rate, gallons per 100 square inch: 0.10 or less.
4. water absorption, percent: 0.02 or less.

C. Prime pipe and fittings with a compatible primer prior to application of tape.

D. Strike Plates: 16 gauge carbon steel, tested and listed by CSA International.

E. In wall Strike Protection Hose: UL listed spiral wound interlocking galvanized steel reduced wall flexible conduit.

F. Non metallic Water Tight Conduit: Schedule 80 rigid PVC, UL 651, with fittings to match to conduit type and material.

G. Multiple Port Manifolds: ANSI LC1b, plastic coated malleable iron, of the same manufacturer of the corrugated stainless steel tubing, tested and listed by CSA International.

2.6 VALVES

A. Gas Ball Valves – 2" and Smaller: Full port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 600 WOG, UL listed for natural gas service.

B. Gas Ball Valves – 2-1/2" to 4": Standard port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 400 WOG, UL listed for natural gas service.

C. Gas Cocks 2 Inch and Smaller: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body, brass or semi-steel plug with full area rectangular port, straightaway pattern, square head, threaded ends.

D. Gas Cocks 2-1/2 Inch and Larger: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body and plug with full area rectangular port, straightaway pattern, single gland, wrench operated, flanged ends.

E. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; internal relief vent,

vent limiter for indoor installation, with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow as indicated on the drawings.

1. CSA listed for 2 PSI gas systems
2. CSA listed for 5 PSI gas systems with factory overpressure protection device.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.3 PREPARATION FOUNDATION FOR UNDERGROUND GAS SERVICE PIPING

A. Pipe Beds for Pre-sleeved Vent Capable Semi-rigid Corrugated Stainless Steel Tubing, PE Pipe and PVC Pipe Conduit: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement or fusion process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Division 22 Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

3.4 PIPE APPLICATIONS

A. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.

B. .

C. Install PE plastic pipe with fusion bond plastic fittings below grade outside the building slab.

3.5 PIPING INSTALLATION

A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.

C. Concealed Locations: As specified below:

1. Inaccessible Above-Ceiling Locations: Install concealed gas piping in inaccessible above-ceiling spaces without valves or unions.
2. Accessible Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves and unions shall not be located in such spaces used as a plenum.

3. In Floors: Install concealed gas piping in concrete floor slabs in an air-tight conduit constructed of Schedule 40 PVC with socket weld joints two pipe sizes larger than the gas pipe served. Extend conduit a minimum of 12" above finish floor and cap air tight at both ends. Vent conduit to the outside with a minimum 2" pipe and terminate with a screened vent cap.
4. Piping In Partitions: Install concealed gas piping in hollow partitions with welded joint (subject to the approval of the authority having jurisdiction) and protect gas piping against physical damage. Install gas piping passing through partitions with no joints or unions inside the partition.
5. Concrete or Masonry Walls: Do not install gas piping in masonry or concrete walls.
6. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter or elevator shaft. This does not apply to accessible above-ceiling space specified above.

D. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

E. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 22 Section "Common Work Results for Plumbing" for additional information.

F. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.

G. Dirt legs and Sediment Traps: Install a dirt leg at points where condensate and impurities may collect, at the outlet of the gas meter, as close to the inlet of each gas

appliance or equipment as possible, and in a location readily accessible to permit cleaning and emptying.

1. Construct dirt legs and sediment traps using a tee fitting with the bottom outlet plugged or capped. Provide a 3" length of pipe and screwed cap for the dirt leg. Use line size pipe for dirt leg, refer to the drawings for sizes. Enter the tee with flow from the top and exit the tee from the side outlet. Install the dirt leg a minimum of 3-1/2" above the roof or floor readily accessible to permit cleaning and emptying.
2. Install line size gas cock, union and dirt leg at each equipment connection; refer to the drawings for sizes. Provide reducers at the equipment connection as required. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

H. Use fittings for all changes in direction and all branch connections.

I. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

J. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

K. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

L. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.

M. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

N. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.

O. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

P. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.

Q. Install unions in pipes 2 inch and smaller, adjacent to each valve, and elsewhere as indicated. Unions are not required on flanged devices. Unions are specified in Section "Basic Piping Materials and Methods".

R. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Dielectric unions and flanges are specified in Section "Basic Piping Materials and Methods".

S. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

T. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.

U. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 22 Section "Expansion Fittings and Loops for Plumbing Piping."

V. Paint Exposed Outdoor Gas Piping: Cleaning and painting of exposed outdoor gas piping is specified in Division 9 Section "Painting".

1. Final color per the architect.

W. Install plastic pipe underground with socket weld plastic joints. Use transition fittings for joining steel to plastic pipe. Installation and pipe bedding shall be per the manufacturer's published installation recommendations.

3.6 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:

1. Adjustable clevis hangers, MSS SP-69 Type 1, for steel pipe 2-1/2" and larger for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual exposed runs on walls.
4. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube.
5. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

SIZE (NPS)	SPACING IN FEET	MIN. ROD SIZE IN INCHES
1/2" to 1"	7	3/8
1-1/4"	8	3/8
1-1/2"	9	3/8
2"	10	3/8
2-1/2"	11	1/2
3"	12	1/2
4"	14	5/8
6"	16	3/4

6. Support semi-rigid corrugated stainless steel tubing with the following maximum spacing:

SIZE (NPS)	HORIZONTAL SPACING IN FEET	VERTICAL SPACING IN FEET
3/8"	4	10
1/2"	6	10
3/4" to 2"	8	10

C. Support vertical piping at every floor.

D. Support gas piping within 12" of each elbow or tee and for gas piping 2-1/2" and larger at each valve or pressure regulator.

E. Support gas piping located on the roof with 4" x 4" x 12" long ACQ rot-proof treated timber blocks. Rot-proof timber blocks are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports.

F. Support gas piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Support pipe at a minimum 7" above the roof.

3.7 PIPE JOINT CONSTRUCTION

A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
2. CAUTION: Remove stems, seats, and packing of valves, and accessible internal parts of piping specialties before brazing.

3. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
4. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
2. Align threads at point of assembly.
3. Apply thread compound for use with gas systems to the external pipe threads. Pipe thread tape is not accepted.
4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

E. Fusion Welded: Joints shall be made by a qualified and approved operator in accordance with Title 49, CFR, Part 192.283 and be made in accordance with pipe manufacturer's recommendations.

3.8 VALVE APPLICATIONS

A. General: The Drawings indicate valve types, locations, and arrangements.

B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.9 VALVE INSTALLATIONS

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install line size gas cock at the outlet of the gas meter set or gas riser and install a line size union downstream of the gas cock outside of the building.

C. Installation of Gas Pressure Regulators:

1. Install a gas cock 10 pipe diameters upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.
2. Install line pressure regulators a minimum of 10 pipe diameters upstream of each atmospheric or power burner equipment connection.
3. Install line pressure regulators a minimum of 10'-0" upstream of each condensing boiler or water heater connection.
4. Install gas pressure regulator relief devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.
5. Install gas pressure regulators with listed vent limiters indoors where allowed by the AHJ. Install with regulator dome vertically upright and level.
6. Install gas pressure regulators located outside the building with the relief port facing down to prevent the entry of moisture with the relief port a minimum of 18" above the roof or finish grade. Remove vent limiter and provide with line size (same size as gas vent relief port) insect screen or gas relief vent and 1" long schedule 40 black steel nipple.

    a. Where manufacturer does not allow the gas pressure regulator to be installed upside down, install gas pressure regulator with regulator dome in the horizontal or vertically upright with factory breather plug.

7. Gas Pressure Regulator Relief Vents: Provide for gas pressure regulators that require them or for vent less regulators where the AHJ requires them. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger. Route vent to the outdoors thru building side wall and turn down or thru the roof and turn down minimum 18" above the roof or grade. Provide with line size (same size as gas relief) insect screen or gas relief vent. Provide vent sizes per the following developed length and include 3 feet of length for each elbow:

    a. 10 feet developed length = size vent one pipe size larger than relief vent outlet size
    b. 20 feet developed length = size vent two pipe size larger than relief vent outlet size
    c. 30 feet developed length = size vent three pipe size larger than relief vent outlet size
    d. 40 feet developed length = size vent four pipe size larger than relief vent outlet size

3.10 TERMINAL EQUIPMENT CONNECTIONS

A. Install line size gas cock upstream and within 6 feet of gas appliance. Install a line size union or flanged connection downstream from the gas cock to permit removal of controls. Install reducer at the gas appliance connection, if required.

B. Install stainless steel flexible gas pipe connector, of size and length as required to complete equipment hook-up of foodservice equipment. Verify appropriate length of flexible gas pipe connector for movement of the foodservice equipment for cleaning.

3.11 ELECTRICAL BONDING AND GROUNDING

A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.12 FIELD QUALITY CONTROL

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

END OF SECTION

SECTION 230010 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 23 of the Specifications and Drawings numbered with prefixes M, MP or ME, or MEP generally describe these systems, but the scope of the Mechanical work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, ductwork, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

A. All work under this Division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturers' requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

BOCA	Building Officials Code Administration
IBC	International Building Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IECC	International Energy Conservation Code
IFC	International Fire Code
IFGC	International Fuel Gas Code
ADA	American Disabilities Act
ADC	Air Diffusion Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
FGI	Facilities Guideline Institute

HI	Hydraulic Institute
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All mechanical work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the mechanical work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.

7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.

    a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

9. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Bedding: Bedding as used in this section refers to the compacted sand or pea gravel installed in the bottom of a trench to immediately support and cover a pipe or duct.
3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
6. Building Fill: Building fill as used in this section refers to borrowed fill material of rock 1” and larger used to fill foundation excavations

1.5 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.

C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.

D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the mechanical systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the

requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. Provide the number of submittals required by Division 01; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual Sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.

4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 01 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

L. Provide welders' qualification certificates.

1.8 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.9 SUBSTITUTIONS

A. Refer to Division 01 and General Conditions for Substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:

1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:

    a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
    d. Same warranty will be furnished for proposed substitution as for specified Work.
    e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
    f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:

1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain data listed in each individual Section.

F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representative.

1.11 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 23 of this specification.

1.12 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video record the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ductwork and ferrous surfaces, including pipe, pipe hangers, equipment stands and supportsshall be painted by the Contractor using materials and methods as specified under Division 09 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:

1. Piping shall be free from obstructions, holes or breaks of any nature.
2. Insulation shall be effective.
3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.17 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 NOT USED

PART 3 - EXECUTION

3.1 PERMITS

A. Secure and pay for permits required in connection with the installation of the Mechanical Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 EXISTING UTILITIES

A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.

B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.

C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.

D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.

E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.3 CUTTING AND PATCHING

A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.

B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.

C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.

D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.

E. Patch around openings to match adjacent construction, including fire ratings, if applicable.

F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.4 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Mechanical Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Mechanical Contractor shall clean material and equipment installed under the Mechanical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.5 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:

1. Submit complete Operation and Maintenance Manuals.
2. Submit complete Record Drawings.
3. Perform special inspections as required in each individual Section.
4. Start-up testing of systems.
5. Removal of temporary facilities from the site.
6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

SECTION 230015 - ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.3 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Division 23 Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, this Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.

B. Refer to Division 26, "COMMON WORK RESULTS FOR ELECTRICAL" for specification of motor connections.

C. Refer to Division 26, "ENCLOSED CONTROLLERS" for specification of motor starters.

D. Refer to Division 26, "ENCLOSED SWITCHES AND CIRCUIT BREAKERS" for specification of disconnect switches and enclosed circuit breakers.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.

B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV23m	DIV23m	DIV26	---
Factory furnished motor starters contactors and disconnects	DIV23m	DIV23m	DIV26	DIV23t
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV26	DIV26	DIV26	DIV23t
Manual operating multi-speed switches	DIV23m		DIV26 DIV26	DIV23t
Control relays	DIV23t	DIV23t	DIV26	DIV23t
Thermostats (low voltage)	DIV23t	DIV23t	---	DIV23t
Thermostats (line voltage)	DIV23m	DIV23m	DIV26	---
Time switches (for mechanical equipment)	DIV23t		DIV23t DIV26	DIV23t
Control power transformers	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers furnished with equipment	DIV23m	DIV23m	DIV26	DIV23t
Temperature control panels (housing controllers)	DIV23t	DIV23t	DIV26	DIV23t
Building controllers, advanced application controllers, and application specific controllers	DIV23t	DIV23t	DIV23t	DIV23t
Motor and solenoid operated valves	DIV23t	DIV23m	DIV23t	DIV23t
Presssure independent control valves DIV23t	DIV23t		DIV23m	DIV23t
Damper operators, PE & switches	DIV23t	DIV23t	DIV23t	DIV23t

DIV23m = Mechanical Contractor
DIV23t = Temperature Controls Sub-Contractor
DIV26 = Electrical Contractor
DIV28 = Electronic Safety and Security

END OF SECTION

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:

1. Mechanical equipment nameplate data.
2. Non-shrink grout for equipment installations.
3. Miscellaneous metals for support of mechanical materials and equipment.
4. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
5. Joint sealers for sealing around mechanical materials and equipment.

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

1. Division 07 Section “Penetration Firestopping” for material and methods for firestopping systems.

2. Division 23 Section "Basic Piping Materials and Methods," for materials and methods for mechanical sleeve seals.
3. Division 23 Section “Direct Digital Controls for HVAC” for integration with building automation system of leak detection system “Water Present” alarm.
4. Division 26 Section “Common Work Results for Electrical” required electrical devices.
5. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 23 Section General Mechanical Requirements.

1. Product data for the following products:

a. Access panels and doors.
b. Joint sealers.
c. Through and membrane-penetration firestopping systems.
d. Plenum insulation.

2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.

3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

    a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."

5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.

    a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

    1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

    1. Provide UL Label on each fire-rated access door.

C. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

PART 2 - PRODUCTS AND MATERIALS

2.1 MECHANICAL EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated mechanical equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.2 GROUT

A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.

B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.

C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.3 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.4 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 15/32 inches.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.3 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General testing, adjustment, and balancing requirements.

B. Testing, adjustment, and balancing of air systems.

C. Testing, adjustment, and balancing of hydronic systems.

D. Testing, adjustment, and balancing of domestic water systems.

E. Testing, adjustment, and balancing of steam systems.

F. Sound and vibration measurement of equipment operating conditions.

G. This section excludes:

1. Testing boilers and pressure vessels for compliance with safety codes;
2. Specifications for materials for patching mechanical systems;
3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
4. Requirements and procedures for piping and ductwork systems leakage tests.

1.2 DEFINITIONS

A. TAB: Testing, adjusting, and balancing.

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

F. Report forms: Data sheets arranged for collecting test data in logical order for submission and review. Data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

G. Terminal: The point where the controlled fluid enters or leaves the distribution system. Examples include inlets and outlets on water terminals, inlets and outlets from air terminal units, and inlets and outlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

H. Main: Duct or pipe containing the major or entire fluid flow of the system.

I. Submain: Duct or pipe containing part of the system capacity and serving two or more branch mains.

J. Branch main: Duct or pipe serving two or more terminals.

K. Branch: Duct or pipe serving a single terminal.

1.3 SUBMITTALS

A. Qualifications:

1. Submit qualifications of TAB agency.
2. Submit qualifications of TAB supervisor.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

C. Sample Forms: Submit sample forms if they are other than the standard forms available from the certification association followed for the project.

D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

E. Progress Reports.

F. Certified TAB Reports:

1. General:

a. Submit within two weeks after completion of testing, adjusting, and balancing.
b. Revise TAB plan to reflect actual procedures and submit as part of final report.
c. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

2. Draft Report: Submit draft copies of report for review prior to final acceptance of Project. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner

specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.

3. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. The final report shall be certified proof of the following:

    a. The systems have been tested, adjusted, and balanced in accordance with the referenced standards.
    b. The report reflects an accurate representation of how the systems have been installed.
    c. The report reflects a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures.
    d. The report is an accurate record of all final quantities measured to establish normal operating values of the systems.

4. Report Format: Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, and cover identification at front and side. Include set of reduced size drawings indicating air outlets, equipment, and thermostat locations identified to correspond with report forms. Divide the report into the following divisions:

    a. General Information and Summary

        1) Include project name, location, altitude, and date.
        2) Identify TAB agency, contractor, owner, architect, and engineer.
        3) Include addresses, contact names, and telephone numbers.
        4) Include certification sheet containing the seal, name, address, telephone number, and signature of the certified TAB Supervisor.
        5) Include actual instrument list, with manufacturer name, serial number, and date of calibration.

    b. Air Systems
    c. Temperature Control Systems

5. Report Forms: Standard forms prepared by the TAB certification standard being followed for each respective item and system to be tested, adjusted, and balanced. If not specified, follow ASHRAE 111.
6. Units of Measure: Report data in I-P (inch-pound) units only.

G. Project Record Documents: Provide drawings that record actual locations of flow measuring stations and balancing devices.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

B. Comply with ASHRAE Handbook, HVAC Applications Volume, Chapter “Testing, Adjusting, and Balancing”, most current edition.

C. TAB Agency Qualifications:

1. Act as the single source of responsibility for TAB of the HVAC systems.
2. Staff the project at all times by qualified personnel.
3. Have a minimum of 5 years documented experience on projects with TAB requirements similar to those required for the project.
4. Certified by one of the following Certification Associations:

a. AABC (NSTSB): Associated Air Balance Council, National Standards for Total System Balance.
b. NEBB: National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
c. TABB: Testing, Adjusting, and Balancing Bureau, SMACNA TAB Procedural Guide.

D. TAB Supervisor and Technician Qualifications:

1. Certified by the same organization as TAB agency.
2. TAB Supervisor shall be a professional engineer licensed in the state in which the project is located.

PART 2 - PRODUCTS AND MATERIALS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Begin work after systems to be tested, adjusted, or balanced are fully operational, duct systems are sealed, piping systems have been tested for leaks, and equipment is operational. Complete work prior to Substantial Completion of the project.

B. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

C. Coordinate with Division 22 drawings for testing, adjusting, and balancing scope of work.

D. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

E. Submit progress reports at least once a week to the General Contractor to communicate status of work so that the TAB work is completed in a timely manner.

F. Notice of Tests: Provide seven days advance notice for each test. Include scheduled test dates and times.

G. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

H. All required instrumentation shall be calibrated to tolerances specified in the referenced standards within a period of six months prior to starting the project.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Motors and bearings are lubricated.
5. Final filters are clean and in place. If required, install temporary media in addition to final filters.
6. Duct systems are clean of debris.
7. Fans are rotating correctly and belts have tension.
8. Fire, smoke, fire/smoke, and volume dampers are in place and open.
9. Air coil fins are cleaned and combed.
10. Volume dampers are installed at locations needed for balancing the air systems.
11. Access doors are closed and duct end caps are in place.
12. Air outlets are installed and connected.
13. Visually inspect duct systems to ensure they are sealed and leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a coordination meeting with all installers whose work will be tested, adjusted, or balanced.

B. Furnish all instruments required for testing, adjusting, and balancing operations.

1. Verify all instruments have been calibrated.

2. Furnish instruments as recommended by the manufacturer for the TAB application.
3. Furnish instruments that are best suited to the function being measured.
4. Furnish instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

C. Furnish additional balancing devices as required for TAB to the appropriate contractor for installation.

D. Obtain copies of approved shop drawings of air handling equipment, terminal outlets, and temperature control diagrams.

E. Obtain manufacturer's fan and terminal device outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

F. Determine best locations in main and branch ductwork for most accurate duct traverses.

G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Balance main ducts and equipment to within plus or minus 5 percent of design airflow.

B. Air Outlets and Inlets: Balance branch ducts and terminal devices to within plus or minus 10 percent of design airflow.

C. Hydronic Systems: Balance to within plus or minus 5 percent of design flow.

3.5 RECORDING AND ADJUSTING

A. Record data regarding design conditions from contract documents and installed conditions from shop drawings including equipment identification number, model number, location, area served, manufacturer, model number, serial number, motor nameplate horsepower and rpm, fan rpm, capacity and electrical voltage, amps and phases.

B. For all systems measure and record the ambient conditions at the time of testing and balancing. Include the following:

1. Dry bulb temperature.
2. Relative humidity.
3. Cloud cover.
4. Wind speed.

5. Time.

C. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.

D. Ensure recorded data represents actual measured or observed conditions.

E. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

F. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

H. Cut insulation around ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

I. Patch and seal insulation, vapor barrier, ductwork, and housings, using materials identical to those removed.

J. Seal ducts and piping and test and repair leaks.

K. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

L. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

M. Check and adjust systems approximately six months after final acceptance and submit report.

N. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive values are obtained.

O. Take all readings at eye level of the indicated value to prevent parallax.

P. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

Q. Take measurements in the system where best suited for the task.

R. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.6 AIR SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

A. Check filters for cleanliness.

B. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

C. Verify volume dampers are installed at locations needed for balancing the air systems.

D. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

E. Determine best locations in main and branch ductwork for most accurate duct traverses.

F. Place outlet dampers in the full open position.

G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

H. Lubricate all motors and bearings.

I. Check fan belt tension.

J. Check fan rotation.

K. Energize fan motors and adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude. Replace fan and motor pulleys as required to achieve design conditions.

L. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

M. Measure air quantities at air inlets and outlets.

N. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

O. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices such as dampers and splitters.

P. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

Q. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

R. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

S. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

T. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

U. Where modulating dampers are provided, take measurements and balance at design conditions. Balance variable volume systems at design air flow rate and at minimum air flow rate.

V. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship to maintain building pressure setpoint.

W. Multi-Zone units with Mixing Dampers: Check for motorized damper leakage. Adjust air quantities with mixing dampers set first at design cooling, then at design heating.

X. For variable air volume boxes, set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

Y. On fan powered VAV boxes, adjust air flow switches for proper operation.

Z. Procedure for establishing minimum and absolute minimum outdoor air damper position on air handling units:

1. Open the minimum outdoor air damper and return air damper fully. Close the economizer air damper.
2. Operate supply fan at design speed and measure the outdoor airflow.
3. If the outdoor airflow is above the scheduled minimum ventilation airflow, adjust the damper linkage on the minimum outdoor air damper so that outdoor airflow equals the scheduled minimum ventilation airflow with damper fully stroked.
4. If outdoor airflow is below the scheduled minimum ventilation airflow, adjust the damper linkage on the return air damper so that outdoor airflow equals the schedule minimum ventilation airflow with the damper fully stroked.
5. Convey the measured setpoint and/or damper position to the BAS installer and note on air balance report.
6. Repeat this procedure to determine damper position for absolute minimum ventilation.

3.7 DOMESTIC WATER SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

A. Before balancing the system perform these steps:

1. Open valves to full open position.
2. Examine plumbing system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices and balancing valves and fittings are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
3. Remove and clean all strainers.
4. Check pump rotation.
5. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
6. Lubricate all motors and bearings.

END OF SECTION 230593

SECTION 230913 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Control dampers.

B. Operators.

C. Input/Output sensors and transmitters.

D. Output control devices.

E. Thermostats.

1.2 DEFINITIONS

A. BAS: Building Automation System.

B. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations

C. Cv: Design Valve Flow Coefficient.

D. DDC: Direct Digital Control.

E. EPDM: Ethylene Propylene Diene Monomer.

F. High voltage: 50 volts or higher.

G. Low voltage: Below 50 volts.

H. PTFE: Polytetrafluoroethylene.

I. TEFZEL: A modified ETFE (ethylene tetrafluoroethylene) fluoroplastic.

1.3 CONTRACTOR RESPONSIBILITIES

A. Reference Division 23 Section ”Electrical Coordination for Mechanical Equipment” for contractor responsibilities.

B. BAS Contractor:

1. Installation of the BAS shall be by the BAS Contractor or his subcontractors.
2. Low voltage control wiring.
3. Coordinate high voltage control wiring to instrumentation and control devices with Division 26. Where high voltage power is required for instrumentation and control devices that is in addition to what is shown on the drawings, the BAS contractor shall cover the cost of providing this wiring.
4. All interlock wiring regardless of voltage (e.g., exhaust fan interlocked to supply fan).
5. Coordinate with Division 26 that motor starters are provided with auxiliary contacts as required for interlocks.
6. Coordinate power wiring to BAS controllers and instrumentation and control devices with Division 26.
7. Coordinate installation of back-box rough-in for wall-mounted control devices sensors, etc. with Division 26. Coordinate with mechanical contractor all locations, quantities, and sizes required for installation by Division 26.

C. Sheet Metal Contractor:

1. Installation of automatic control dampers, smoke control dampers, and necessary blank off plates.
2. Access doors where and as required.

D. Mechanical Contractor:

1. Coordinate conduit and wall box rough-in, power wiring and magnetic starter requirements for controls and mechanical equipment with Division 26.

1.4 SUBMITTALS

A. Refer to Division 01 for submittal procedures.

B. Product Data: Provide description and engineering data for each control system component. Include dimensions, capacities, size, performance characteristics, electrical characteristics, and finishes of materials.

C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

D. Schedule for control valves and actuators, including the following:

1. Tag.
2. Quantity.
3. Model number.
4. Equipment served.

5. Flow at project design conditions.
6. Selected valve flow coefficient (Cv). For butterfly valves, submit the corresponding valve position at which the Cv is calculated.
7. Pressure differential drop across valve at project design flow conditions and selected Cv.
8. Maximum close-off pressure.
9. Valve Configuration (2-way/3-way).
10. Valve Normal Position and Fail Position (e.g., NO/FO; normally open/fail open).
11. Valve Size.
12. Line Size.
13. Valve Type.
14. Actuator Signal Type (Open/Close, Modulating 0-10 Vdc, 2-10 Vdc, 4-20 mA, etc.)
15. Torque required to close valve at pump shutoff head.
16. Selected actuator maximum torque output.

E. Manufacturer's Instructions: Provide for all manufactured components.

F. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

G. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.

H. Warranty: Submit manufacturer warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

C. Control valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ANSI and MSS standards.

D. Measurement devices and sensors shall be calibrated using NIST traceable standards.

1.6 WARRANTY

A. Correct defective Work within a one year period after Substantial Completion.

B. Provide extended warranty for control devices and equipment as specified herein.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

A. Dampers shall be factory fabricated and sized as shown on drawings and as specified.

B. Individual damper sections shall not be larger than 48 inches x 60 inches. Provide a minimum of one damper actuator per section.

C. Performance: Test in accordance with AMCA 500-D.

1. Pressure Drop: Unless otherwise scheduled or indicated on the Drawings, size control dampers as follows:

a. Modulating Dampers: Provide dampers with linear flow characteristics. Size modulating dampers based on the smaller of the following.

1) Maximum velocity of 1,500 feet per minute.
2) Maximum Full-open air pressure drop of 0.1 inches W.C.

b. Two Position Dampers: Dampers shall be full duct size and selected to minimize pressure drop.

2. Leakage:

a. Motorized dampers shall not exceed 4.0 CFM/square foot in full closed position at 1 inch W.G. pressure differential across damper.

D. Frames: Galvanized steel, extruded aluminum, or stainless steel, welded or riveted with corner reinforcement.

1. Use minimum 16 gauge for rectangular dampers.
2. Use minimum 20 gauge for round dampers.
3. For aluminum frames, use 1/8 inch thick material.
4. All damper frames shall have a flange for duct mounting.
5. Reference Part 3 Execution for application of the material type.

E. Blades: Galvanized steel, extruded aluminum, or stainless steel, maximum blade size 6 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws.

1. Use minimum 16 gauge for rectangular dampers.
2. Use minimum 16 gauge for round dampers.
3. For aluminum blades, use 1/8 inch thick material.
4. The blades shall be suitable for the air velocities to be encountered in the system.
5. Dampers longer than the maximum blade length shall be fabricated in sections.
6. Reference Part 3 Execution for application of the material type.

F. Blade Seals: Synthetic elastomeric inflatable or Neoprene, mechanically attached, field replaceable.

1. Installed along the top and bottom of the frame and on all mating surfaces.

G. Jamb Seals: Spring stainless steel.

1. Installed inside the frame sides.

H. Shaft Bearings: One of the following as recommended by manufacturer for the application:

1. Oil impregnated sintered bronze.
2. Graphite impregnated nylon sleeve with thrust washers at bearings.
3. Lubricant free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.
4. Molded synthetic bearings.

I. Linkage Bearings: One of the following as recommended by manufacturer for the application:

1. Oil impregnated sintered bronze
2. Graphite impregnated nylon.

J. Maximum Pressure Differential: 6 inches wg.

K. Temperature Limits: -40 to 200 degrees F.

L. Manufacturers:

1. Greenheck.
2. CESCO.
3. Pottorff.
4. Nailor.
5. Ruskin.

M. Reference the Damper Schedule in Part 3 for basis of design damper model and material for the application.

2.2 OPERATORS

A. General:

1. Voltage: Voltage selection shall be as required to achieve the required torque for the application.

a. Reference Part 3 for Damper Operator Voltage Schedule.

2. Type: Motor operated, with or without gears. Motor type shall be continuous duty.
3. Construction:

    a. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
    b. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
    c. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

4. Field Adjustment:

    a. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
    b. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

5. Two-Position Actuators: Single direction, spring return or reversing type. End-switches shall be integral to the actuator to determine actuator status.
6. Modulating Actuators:

    a. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
    b. Control Input Signal:

        1) Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
        2) Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-Vdc or 2- to 10-Vdc and 4- to 20-mA signals.
        3) Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.

    c. Programmable Multi-Function:

        1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
        2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
        3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

7. Position Feedback:

a. Where indicated on the controls drawings, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
b. Where indicated on the controls drawings, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
c. Actuator shall contain position indicator and graduated scale indicating open and closed travel limits.

8. Integral Overload Protection:

a. Provide against overload throughout the entire operating range in both directions.
b. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

9. Attachment:

a. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to device without the need for connecting linkages.
b. Attach actuator to device drive shaft in a way that ensures maximum transfer of power and torque without slippage.

10. Temperature and Humidity:

a. Temperature: Suitable for operating temperature range encountered by application.
b. Humidity: Suitable for humidity range encountered by application, non-condensing.

11. Enclosure:

a. Suitable for ambient conditions encountered by application.
b. NEMA 4 for indoor wash-down or wet locations.
c. NEMA 4X, Belimo ZS-300, or equivalent; for outdoor applications.
d. Provide actuator enclosure with heater and control where required by application.

12. Stroke Time:

a. Coordinate with stroke time indicated on the control drawings.
b. Unless otherwise noted, select operating speed to be compatible with equipment and system operation.

B. Damper Operators:

1. Controls contractor shall size damper operator.
2. Sizing: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal

against maximum system pressures. Provide spring return for two position control and for fail safe operation.

a. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
b. Provide one operator for maximum 20 sq ft damper section or maximum 7 in-lb/sq ft damper area.

3. Fail Positions:

a. Spring return to normal position as indicated on freeze, fire, temperature, or loss of power protection. Normal positions are indicated on the control drawings.

1) Return air damper, normally open.
2) Outside air damper, normally closed.
3) Exhaust/Relief air damper, normally closed.

b. Operator shall fail in place for all other applications not listed under spring return.
c.

2.3 INPUT/OUTPUT SENSORS AND TRANSMITTERS

A. General:

1. Performance Requirements:

a. Device must be compatible with project DDC controllers.
b. Elements used shall be general-purpose type.
c. Provide transmitters or transducers with sensors as required, with range suitable for the system encountered.

1) Transmitters and transducers shall have offset and span adjustments.
2) Shock and vibration shall not harm the transmitter or transducer.
3) Transmitters and transducers shall have a zeroing capability of readjusting the transmitter zero.

d. Accuracy requirements shall include the combined effects of linearity, hysteresis, repeatability, and the transmitter.

2. Output: Linear, proportional type over shielded cable pair, 4 - 20 mA or 0 – 10 Vdc signal.
3. Input Power: Low voltage, nominal 24 Vdc.

B. Temperature Sensors:

1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy. Sensor shall be UL 873 listed for temperature equipment.
2. Performance Requirements:

    a. Thermistor:

        1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
        2) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
        3) Resolution: Plus/minus 0.2 degrees F minimum.
        4) Heat Dissipation Constant: 2.7 mW per degree C.
        5) Drift: 0.04 degree F after 10 years within temperature range.

    b. RTD:

        1) Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
        2) Accuracy (All): Plus/minus 1 degree F minimum, unless otherwise noted below.

            a) Room Sensor Accuracy: Plus/minus 0.5 degrees F minimum.
            b) Chilled Water Accuracy: Plus/minus 0.5 degrees F minimum.
            c) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.

        3) Resolution: Plus/minus 0.2 degree F.
        4) Drift: 0.04 degrees F after 10 years within temperature range.

    c. Sensing Range:

        1) Provide limited range sensors if required to sense the range expected for a respective point.
        2) Use RTD type sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.

    d. Wire Resistance:

        1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
        2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.

    e.

2.4 OUTPUT CONTROL DEVICES

A. Control Relays:

1. Provide relay with contact rating, configuration, and coil voltage that is suitable for the application.
2. Provide NEMA 1 enclosure when relay is not installed in a local control panel.
3. Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator.
4. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus/minus 200 percent minimum from setpoint.

B. Fan Speed Controllers:

1. Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.

2.5 THERMOSTATS

A. General:

B. Electric Room Thermostats:

1. Type: 24 volts, two position switch, programmable with setback/setup temperature control.
2. Covers: Locking with set point adjustment and indication.
3. Setpoint functional range: 45 degrees F to 90 degrees F.

C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

A. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.

B. General Workmanship:

1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
2. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
3. Install all equipment in readily accessible locations.
4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
5. Install all products in accordance with manufacturer's instructions.

C. Sensors:

1. Mount sensors rigidly and adequately for the environment within which the sensor operates.
2. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
3. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
4. Sensors used in mixing plenums and hot and cold decks shall be of averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
5. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 foot of sensing element for each square foot of coil area.
6. Check and verify location of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Locate 48 inches above floor. Align with adjacent lighting switches and humidistats.

    a. Install devices to meet ADA requirements unless otherwise noted on the plans.

D. Control Dampers:

1. Install dampers with extruded aluminum or stainless steel frames and blades in corrosive environments and areas with high humidity.
2. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

3. Clearance:

    a. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
    b. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

4. Service Access:

    a. Dampers and actuators shall be accessible for visual inspection and service.
    b. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Division 23 Section, “Air Duct Accessories.”.

5. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting.
6. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
7. Provide mixing dampers of parallel blade construction arranged to mix streams. Where shown on the drawings, provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
8. Provide isolation (two position) dampers of parallel blade construction.
9. Provide opposed blade damper configuration for all other applications.
10. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
11. After installation of low-leakage dampers and seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

E. Operators:

1. Mount and link control damper actuators according to manufacturer’s instructions.

    a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
    b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
    c. Provide all mounting hardware and linkages for actuator installation.

2. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5 degree available for tightening the damper seals.

F. Control Panels:

1. Install control panels where shown on the drawings and where required to house controllers for the controlled systems and equipment.
2. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
3. Coordinate 120V power requirements with Division 26 to panels used for the building automation system and transformers for low voltage power to controllers.

G. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

H. Provide an insulation standoff on control devices, cables, and other items that do not require flush mounting to ductwork, piping, or equipment.

3.3 8MAINTENANCE

A. Refer to Division 01 closeout requirements for additional requirements relating to maintenance service.

B. Provide service and maintenance of control system for one year from Date of Substantial Completion.

C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

3.4 STARTUP AND DEMONSTRATION

A. Control Dampers and Valves:

1. Stroke and adjust control valves and dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
2. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
3. For control valves and dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
4. Verify that all two-position dampers and valves operate properly and that the normal positions are correct.
5. Verify that all modulating dampers and valves are functional, that the start and span are correct, that direction and normal positions are correct, and that they achieve proper closure.

3.5 DAMPER SCHEDULE

SERVICE	RUSKIN MODEL	MATERIAL
Outside Air Control	CD-50	Aluminum
Fire and Smoke Control	FSD-60	Galvanized Steel
Corrosive Environments	CD-35	Aluminum or Stainless steel
All Other	CD-35	Galvanized Steel

3.6 DAMPER OPERATOR VOLTAGE SCHEDULE

SERVICE	VOLTAGE
Interlocked with HVAC fans	120V
Multi-section dampers	120V
Large dampers (> 60 inches in any dimension)	120V
All other operators control wiring	24V

1. Note: Coordinate with Division 26 if 120V power is required for operator to achieve appropriate torque requirements for damper actuation.

END OF SECTION

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes:

1. Rectangularmetal ducts for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.

B. Related Sections:

1. Division 23 Section "Common Work Results for HVAC," for materials and methods for wall penetrations and equipment pads.

1.2 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.4 SUBMITTALS

A. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

1. Duct Liner.
2. Sealing Materials.
3. Fire-Stopping Materials.

B. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Duct layout, indicating pressure classifications, duct gauge and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

C. Coordination drawings for ductwork installation in accordance with Division 23 Section "General Mechanical Requirements." In addition to the requirements specified in "General Mechanical Requirements" show the following:

1. Coordination with ceiling suspension members.
2. Spatial coordination with other systems installed in the same space with the duct systems.
3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.

D. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 Section "General Mechanical Requirements" and Division 1.

E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."

B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.

C. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
2. NFPA 90B, “Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
3. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

D. Sheet Metal and Air Conditioning Contractors’ National Association, Inc. (SMACNA): Provide ductwork systems in conformance with “HVAC Duct Construction Standards – Metal and Flexible,” latest edition.

E. Underwriter’s Laboratories (UL): Comply with the UL standards listed within this section. Provide mastic and tapes that are listed and labeled in accordance with UL 181A and marked according to type.

1.6 PROTECTION AND REPLACEMENT

A. Protect ductwork during shipping and storage from dirt, debris and moisture damage. Provide plastic covers over ends of ductwork during shipping, storage and installation.

B. Replace duct liner that is damaged and cannot be repaired satisfactorily, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installing new duct liner.

PART 2 - PRODUCTS AND MATERIALS

2.1 SHEET METAL MATERIALS

A. Sheet Metal, General: Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A 700.

B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653, Coating Designation G 90. Provide mill phosphatized or galvanealed finish for surfaces of ducts exposed to view that is to be field painted. Provide bright galvanized finish for ductwork that is exposed to view and not field painted.

C.

D. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SEALING MATERIALS

A. Joint and Seam Sealants, General:

1. The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
2. Duct tape shall not be used as a sealant on any ducts.
3. Sealants shall be ASTM E84 or UL 723 listed with a flame spread index not more than 25 and a smoke-developed index not more than 50.

B. Joint and Seam Tape: 2 inches wide, glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.

D. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 70 percent solids.

1. Manufacturers:

a. Childers CP-140.
b. Duro Dyne SGD.
c. Fosters 32-14.
d. Approved equal.

E. Water-Based Joint and Seam Sealant, Non-Fibrated: UL 181 listed. Sealant shall be rated to ±15 inches w.g. Sealant shall have a service temperature of –25 to 200 F and be freeze/thaw stable through 5 cycles.

1. Manufacturers:

a. Childers CP-146.
b. Design Polymerics DP 1010.
c. Ductmate Proseal/Fiberseal.
d. Duro Dyne Duroseal.
e. Fosters 32-19
f. United Duct Sealer (Water Based).
g. Hardcast 601.

F. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flanged Gasket Tapes: Butyl gasket shall be UL 181 classified. Gasket size shall be minimum 5/8 inch x 3/16 inch and have nominal 100 percent solid content. It shall be non-oxidizing, non-skinning and have a service temperature of –25 to 180 F.

1. Manufacturers:

    a. Design Polymerics DP 1040.
    b. Ductmate 440.
    c. Hardcast 1902.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.

1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
2. Straps and Rod Sizes: Conform with SMACNA HVAC Duct Construction Standards, 2005 Edition, for sheet steel width and gauge and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.

1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
2. For stainless steel ducts, provide stainless steel support materials.
3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

2.4 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Tables 2-1 through 2-28, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
2. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
3. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area,

as indicated in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 2-9, unless they are lined or are externally insulated.

C. Field Painted Ductwork: Provide mill phosphatized finish on exposed surfaces of rectangular ductwork and duct fittings to be field painted.

2.5 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 2005 Edition, Figures 4-1 through 4-8. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper, 3/8 inch square shaft, U-bolt, nylon bushings, locking quadrant, and 2 inch insulation build-out for branch duct connections and take-offs to individual diffusers, registers and grilles. 45 degree, high efficiency, rectangular/round branch duct takeoff fittings shall be Flexmaster STO with model BO3 damper or equal.

B. Provide radius elbows, turns, and offsets with a minimum centerline radius of 1-1/2 times the duct width. Where space does not permit full radius elbows, provide short radius elbows with a minimum of two continuous splitter vanes. Vanes shall be the entire length of the bend. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.

PART 3 - EXECUTION

3.1 DUCT MATERIAL APPLICATION

A. All ducts shall be galvanized steel.

3.2 DUCT INSTALLATION, GENERAL

A. Install products in accordance with manufacturer’s instructions.

B. Duct System Pressure Class: Construct and install each duct system except factory-manufactured ductwork for the specific duct pressure classification indicated. For factory-manufactured ductwork, refer to Paragraph “Factory-Manufactured Ductwork”.

1. Return and Outdoor Air Ducts: 2 inches water gauge, negative pressure.
2. Exhaust Air Ducts: 2 inches water gauge, negative pressure.

C. Install ducts with the fewest possible joints.

D. Seal duct joints with the appropriate sealing material.

E. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

F. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

G. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Cover ducts openings during construction with duct caps or three-mil plastic to protect inside of (installed and delivered) ductwork from exposure to dust, dirt, paint and moisture. Do not use duct tape on ducts that will be exposed or painted.

J. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

K. Coordinate layout with lighting layouts and similar finished work.

L. Exposed Ductwork: Exposed ductwork shall be free of defects, dents or blemished surfaces to provide a smooth, finished appearance. Any damaged material shall be replaced with new material. Ductwork that is to be field painted shall have surfaces wiped clean of lubricant, dirt, or fil prior to priming and painting. Apply primer and paint of type as recommended by paint manufacturer for duct material and finish.

M. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

N. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.3 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints as follows:

1. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed to meet SMACNA Seal Class A.
2. Seal class shall apply to all supply, return, outdoor air, and exhaust ductwork, regardless if the duct is positively or negatively pressurized.

B. Seal externally insulated ducts prior to insulation installation.

C. Ductwork installed exterior to the building shall have longitudinal and transverse joints welded or sealed airtight with weatherproof heavy liquid sealant applied according to manufacturer's instructions.

3.4 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in Chapter 5 of the SMACNA "HVAC Duct Construction Standards", 2005 Edition.

B. Installation of Wire Roper Hanger Systems:

1. Install in accordance with manufacturer’s instructions.
2. Wire rope hanger spacing shall not exceed 8 feet. Supported load shall not exceed manufacturer’s recommended load rating.
3. Where approved by local code authority, the loop system may be swaged directly on to a seismic approved bracket or appropriate end fixing.

C. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

D. Support vertical ducts at a maximum interval of 16 feet and at each floor.

E. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated. Hangers and supports shall be fastened to building joists or beams. Do not attach hangers and supports to the above floor slab or roof with sheet metal screws.

3.5 PENETRATIONS

A. Exterior Wall Penetrations: Seal duct penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for additional information.

3.6 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Air Duct Accessories."

B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 4-5 and 4-6.

C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 7-6 and 7-7. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor’s option, a flexible elbow assembly as specified in Division 23 Section "Air Duct Accessories."

D. Fan Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 7-8.

3.7 FIELD QUALITY CONTROL

A. Remove temporary protection devices over ductwork prior to starting equipment and turning the system over to the owner.

3.8 ADJUSTING AND CLEANING

A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING FOR HVAC" for requirements and procedures for adjusting and balancing air systems.

B. Vacuum duct systems prior to final acceptance to remove dust and debris.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this Section.

B. Types of ductwork accessories required for project include the following:

1. Dampers.

    a. Low pressure manual dampers.
    b. Counterbalanced backdraft dampers.

2. Duct hardware.
3. Metal duct connectors.

C. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not work of this Section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 2005 Edition.
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance:

    a. Construct, test, and label fire dampers in accordance with current edition of UL Standard 555 "Fire Dampers". Construct, test, and label smoke dampers in accordance with current edition of UL Standard 555S "Smoke Dampers".
    b. Construct flexible ductwork in compliance with UL Standard 181 “Factory-Made Air Ducts and Connections”.
    c. Duct tape shall be labeled in accordance with UL Standard 181B and marked 181B-FX.

d. Duct clamps shall be labeled in accordance with UL Standard 181B and marked 181B-C.
e. Grease exhaust duct wrap shall meet the fire protection requirements defined by UL Standard 1479 “Fire Tests of Through-Penetration Firestops.”.
f. Fire rated duct wrap shall meet the fire protection requirements defined by UL Standard 1479 “Fire Tests of Through-Penetration Firestops.”.

4. NFPA Compliance:

a. Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories. Comply with NFPA 90B “Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
b. Comply with NFPA 96 “Ventilation Control and Fire Protection of Commercial Cooking Operations” for fire-rated grease exhaust ducts.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory including dimensions, capacities and materials of construction; and installation instructions. Submit performance data for duct silencers including insertion loss performance in octave bands from 63 Hz to 8,000 Hz and pressure drop at specified airflow.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.4 SPARE PARTS

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

PART 2 - PRODUCTS AND MATERIALS

2.1 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multi-blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

1. Material: Galvanized steel for standard air systems, aluminum for wet or natatorium environments and stainless steel for corrosive environments.
2. Construction: Bearings shall be corrosion resistant, molded synthetic and axles shall positively lock into the damper blade. Extended shafts and standoff bracket for insulation clearance shall be metal material. Provide with locking quadrant.
3. Blade Seals: Where dampers are used for shutoff duty, provide Neoprene seals for round dampers and silicone for rectangular dampers.
4. Dampers shall be Greenheck Model MBD Series, or approved equal.

B. Control Dampers: Refer to Division 23 section Instrumentation and Control Devices for HVAC for control dampers; not work of this section.

C. Counterbalanced Backdraft Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to open at indicated static pressure. Construct frames and blades of minimum 16-ga aluminum. Provide minimum 1/2" diameter, corrosion-resistant bearings and 1/2" diameter, galvanized or stainless steel axles. Blade edge seals shall be mechanically locked into blade edge. Blade seals shall be neoprene for round dampers. Blade seals shall be silicone or vinyl for rectangular dampers.

D. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.
2. Arrow United Industries.
3. Cesco
4. Greenheck
5. Louvers & Dampers, Inc.
6. Nailor Industries, Inc.
7. Pottorff
8. Ruskin Mfg. Co.
9. TAMCO
10. Vent Products

2.2 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ductmate Industries.
2. Elgen Manufacturing Co., Inc.
3. Ventfabrics, Inc.
4. Young Regulator Co.

2.3 METAL DUCT CONNECTORS

A. Description: Factory-fabricated, slide-on transverse flange connectors, corners, cleats, gaskets, and components. Material, gauge, and shape shall match the connecting ductwork.

B. Manufacturers: Subject to compliance with requirements, provide duct connectors by one of the following or approved equal:

1. Ductmate Industries.
2. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

C. Provide turning vanes, of same gauge as ductwork, rigidly fastened with guide strips in ductwork having an offset of 45 degrees or more. Vanes shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

B. Label access doors in accordance with Division-23 section "Identification for HVAC Piping and Equipment".

C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing for HVAC".

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following types of power ventilators:

1. Roof-mounted exhausters

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for selected models, including specialties, accessories, and the following:

a. Certified fan performance curves with system operating conditions indicated.
b. Certified fan sound power ratings.
c. Motor ratings and electrical characteristics plus motor and fan accessories. For fans with factory-furnished starters or variable frequency drives, include short circuit current ratings.
d. Materials gages and finishes, including color charts.
e. Dampers, including housings, linkages, and operators.

2. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
3. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
4. Maintenance data for power ventilators, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23 Section "General Mechanical Requirements."

1.3 QUALITY ASSURANCE

A. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.

B. UL Compliance: Fans and fan motors shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

C. UL Compliance: Fans and components shall be UL listed and labeled.

D. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

E. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

F. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.4 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of structural steel support members.

1.5 SPARE PARTS

A. Furnish one additional complete set of belts for each belt-driven fan.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

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

1. Upblast Propeller Roof Exhaust Fans:

a. Acme Engrg. & Mfg. Corp.
b. Carnes Company, Inc.
c. Cook (Loren) Co.
d. Greenheck Fan Corp.
e. Hartzell Fan, Inc.
f. PennBarry.
g. RuppAir Management Systems.
h. Twin City Fan Company
i.

2.2 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.3 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished; with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor: 1.4.

D. Belts: Oil-resistant, nonsparking, and nonstatic.

1. Fans used for smoke control applications shall have 1.5 times the number of belts required for the design duty with a minimum of two belts.

E. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

F. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA L(50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

G. Hazardous Duty: Provide fans with spark resistant construction and explosion proof motor where specified in the schedule.

H. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.

2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.4 UPBLAST PROPELLER ROOF EXHAUST FANS

A. General Description: Belt-driven or direct-drive as indicated, propeller fans consisting of housing, wheel, butterfly-type discharge damper, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Wind Band, Fan Housing, and Base: Reinforced and braced galvanized steel, containing galvanized steel butterfly dampers and rain trough, motor and drive assembly, and fan wheel.

C. Wind Band, Fan Housing, and Base: Reinforced and braced aluminum, containing aluminum butterfly dampers and rain trough, motor and drive assembly, and fan wheel.

1. Dampers Rods: Steel with bronze bearings.
2. Dampers Rods: Steel with nylon bearings.

D. Fan Wheel: Dynamically and statically balanced, replaceable, cast-aluminum blades fastened to cast-aluminum hub. Factory-set pitch angle of blades.

E. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub. Factory set pitch angle of blades.

F. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings.

G. Motors and Fan Wheel Pulleys: Adjustable pitch. Select pulley so that pitch adjustment is at the middle of the adjustment range at design conditions.

H. Motors Mounts: Outside of the fan cabinet with adjustable base for belt tensioning, drive assembly and belts enclosure, and weatherproof housing of same material as fan housing.

I. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports.

2.5 MOTORS

A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

C. Temperature Rating: 90 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class B Insulation).

D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.

1. Bases: Adjustable.
2. Bearings: The following features are required:

a. Ball or roller bearings with inner and outer shaft seals.
b. Grease lubricated.
c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

3. Enclosure Type: The following features are required:

a. Open drip-proof motors where satisfactorily housed or remotely located during operation.
b. Guarded drip-proof motors where exposed to contact by employees or building occupants.

4. Overload protection: Built-in, automatic reset, thermal overload protection.
5. Noise rating: Quiet.
6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B.
7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

F. Starters, Electrical Devices, and Wiring: Starters, electrical devices and connections are specified in Division 26.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions.

B. Secure roof-mounted fans to pre-engineered roof equipment supports in accordance with the requirements specified in Section “Hangers and Supports for HVAC Piping and Equipment.”

C. Ceiling Units: Suspend units from structural steel support frame using steel wire or metal straps.

D. Install vibration isolation for equipment as specified in Division 23 Section “Vibration Isolation for HVAC Piping and Equipment.”

E. Arrange installation to provide access space around fans for service and maintenance.

3.2 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.3 STARTUP

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
7. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

    a. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.
3. Shut unit down and reconnect automatic temperature control operators.
4. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

3.4 DEMONSTRATION

A. Demonstration Services: Train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION

SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this Section.

B. Types of outlets and inlets required for project include the following:

1. Louvers.

C. Refer to other Division 23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this Section.

D. Refer to other Division 23 sections for balancing of air outlets and inlets; not work of this Section.

1.2 RELATED REQUIREMENTS

A. 230548 – Seismic Controls for Mechanical Systems, for seismic controls.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. AHRI Compliance: Test and rate air outlets and inlets in accordance with AHRI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings at specified airflows. Indicate selections on data.
4. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
5. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

C. Color Samples for Initial Selection: Manufacturer’s color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: Provide samples of diffusers, registers, and grilles, in manufacturer’s standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

1.5 SPARE PARTS

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

PART 2 - PRODUCTS AND MATERIALS

2.1 LOUVERS

A. General: Except as otherwise indicated, provide manufacturer's standard louvers as scheduled or indicated on the drawings; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.

B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

1. Structural Performance: Louvers shall withstand the effects of gravity loads and wind and/or seismic loads as defined in the applicable building code for the installed location without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.

E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Louver Supports: Louver design shall limit span between visible mullions to 10' and shall incorporate structural supports required to withstand a wind load of 20 lbs. per sq. ft.

G. Intermediate Blade Supports: Where needed blade supports shall be provided by louver manufacturer on the rear of blade only.

H. Louver Blank-Off Panels: Blank off any unused portions of louver with lined galvanized sheet metal panels and seal airtight. Back of panels shall be insulated with 1” thick, 3 lb. density duct liner.

I. Manufacturers: Subject to compliance with requirements, provide louvers of one of the following:

1. American Warming & Ventilating Inc.
2. Arrow United Industries, Inc.
3. Carnes Co.; Div. of Wehr Corp.
4. Cesco
5. Greenheck
6. Industrial Louvers, Inc.
7. Louvers & Dampers, Inc.
8. Nailor Industries, Inc.
9. Pottorff
10. Ruskin Mfg. Co.

11. Tampco.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed for compliance with installation tolerances and conditions that would affect the performance of the equipment. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, to interface installation of air outlets and inlets with other work.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before beginning air balance.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any air device that has damaged finishes.

END OF SECTION

SECTION 235500 - FUEL FIRED HEATERS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following:

1. Gas-fired unit heaters

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

1. Division 22 Section “Natural Gas Systems” for natural gas equipment connection requirements.
2. Division 23 Sections for breechings, temperature controls, and other mechanical equipment not specified in this Section, but required for a complete installation.
3. Division 26 Sections for electrical work including motor starters, disconnects, wires/cables, raceways, and other electrical equipment devices not specified in this Section, but required for a complete installation.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Division 1 and Division 23 Section “Common Work Results for HVAC”.

1. Product data including weights, dimensions, metal gages, and data on features and components. Include plan and elevation views of units, minimum clearances, data on ratings and capacities and installation instructions.
2. Maintenance data for products for inclusion in "Operating and Maintenance Manual" specified in Division 1.
3. Wiring diagrams from manufacturers detailing requirements for electrical power and control wiring for heaters. Include ladder-type wiring diagrams for interlock and control wiring required for field installation. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70, "National Electrical Code."

1.4 SPARE PARTS

A. General: Furnish spare parts matching products installed, as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

1. Fan Belts: Furnish quantity equal to 15 percent of the number of belts installed for centrifugal fans of unit heaters, but not less than one set.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

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

1. Unit Heaters, Gas, Propeller Fan:

a. Dunham-Bush, Inc.
b. Hartzell Fan, Inc.
c. Hastings Industries, Inc.
d. Lennox Industries, Inc.
e. Modine Mfg. Co.
f. Rapid Engineering
g. Reznor.
h. Sterling Heating Equipment Div.
i. The Trane Co.

2.2 FUEL-FIRED HEATERS, GENERAL

A. Types, Minimum Ratings, Locations, and Mountings: As indicated.

1. Gas-Fired Heaters and Accessory Items: NFPA 54, "National Fuel Gas Code."

a. AGA Approval: Heaters design certified and labeled by the American Gas Association.
b. Type of Gas: Heaters designed and built to burn natural gas with characteristics the same as those of the gas available at the Project site.

2. Oil-Fired Heaters and Accessory Items: NFPA 31, "Standard for Installation of Oil-Burning Equipment."

a. NRTL Approval: Heaters bear the label of a National Recognized Testing Laboratory (NRTL) that meets the requirements defined in OSHA Regulation 1910.7.

B. Assembly and Wiring: Heaters factory assembled, piped, wired, and tested.

C. Heater Electrical Rating: 115 V a.c. except as otherwise indicated.

D. Propeller Fans: Factory-balanced, resilient-mounted, with aluminum blades and 100-percent steel blade guard.

E. Centrifugal Fans: Factory-balanced, resilient-mounted, steel, belt driven with adjustable-pitch motor sheave except as otherwise indicated.

F. Motors: Totally enclosed with internal thermal overload protection and complying with Division 15 Section "Motors," except as otherwise indicated.

1. Heater Motors: Energy efficient types as defined in Division 23 section "Common Motor Requirements for HVAC Equipment."

G. Concentric Terminal Vent Assembly: Combined combustion air inlet and power vent outlet. Include adapter assembly for connection to inlet and outlet pipes, and flanges for wall penetration.

H. Control Transformer: Integrally mounted. 120 V a.c./24 V a.c.

2.3 TEMPERATURE CONTROL

A. Wires and cables are specified in Division 26.

2.4 FINISHES

A. External Casings and Cabinets: Baked enamel over corrosion-resistant treated surface.

PART 3 - EXECUTION

3.1 INSTALLATION AND CONNECTION

A. Installation and connection of gas-fired heaters and associated fuel and vent features and systems installed and connected in accordance with NFPA 54, applicable local codes and regulations, and manufacturer's printed installation instructions.

1. Connect gas piping to furnace according to requirements of Division 22 Section "Natural Gas Systems." Provide union with sufficient clearance for burner removal and service.
2. Connect vents in accordance with Division 23 Section "Breechings, Chimneys and Stacks."

B. Connect condensate drain pans using Type M copper tubing with streamline drainage fittings and soldered joints. Extend to nearest equipment drain or floor drain. Construct vented, deep trap at connection to drain pan and install cleanouts at changes in direction. Terminate to suit local code requirements, except where stricter methods are indicated.

C. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.

1. Spring hangers are specified in Division 23 section "Vibration Isolation for HVAC Piping and Equipment."

D. Controls: Wiring and connections are specified in Division 26.

E. Install controls as specified in Division 23 Controls section.

F. Connect ducts in accordance with Division 23 section "Metal Ductwork."

3.2 IDENTIFICATION

A. Identify heaters and connections in accordance with Division 23 section "Identification for HVAC Piping and Equipment."

3.3 STARTUP

A. Test functions, operations, and control sequences and protective features. Adjust to assure operation is in accordance with design.

B. Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.4 CLEANING AND ADJUSTING

A. Cleaning: Upon completion of installation, inspect heaters and associated components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

B. Adjusting: Make burner and other unit adjustments for optimum heating performance and efficiency. Adjust heat distribution features, including louvers, vanes, shutters, dampers, and reflectors, to provide optimum heat distribution for objects, personnel, and spaces served.

3.5 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of twohours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:

1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

SECTION 260010 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.

B. Division 26 of these Specifications, and Drawings numbered with prefixes E, generally describe these systems, but the scope of the electrical work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. Drawings are graphic representations of the Work upon which the Contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, outlets and circuits without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

1.3 DEFINITIONS

A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:

1. Furnish: “To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations.”
2. Install: “To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use.”
3. Provide: “To furnish and install complete, and ready for the intended use.”
4. Furnished by Owner (or Owner-Furnished) or Furnished by Others: “An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.
5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division.

    a. A Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.

6. Contract Administrator: Where referenced in this Division, “Contract Administrator” is the primary liaison between the Owner and the Contractor. Specifically, for this project this is “the Architect”.
7. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
8. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ, and standards that meet the specified criteria.
9. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.

    a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

10. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the

function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. Manufacturers: The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.

D. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached indicated sub-grade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Sub-base: as used in this section refers to the compacted soil layer used in pavement systems between the sub-grade and the pavement base course material.
3. Sub-grade: as used in this section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction from the Contract Administrator.

1.4 REFERENCE STANDARDS

A. Execute all work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator’s and Engineer’s attention in sufficient time, prior to the opening of bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.

B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction

of the Contract Administrator and Engineer, without additional compensation. Contractor will be held responsible for any violation of the law.

C. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.

D. All material, manufacturing methods, handling, dimensions, methods of installation, and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them:

IBC International Building Code
ADA Americans with Disabilities Act
AIA Guidelines for Design and Construction of Hospital and Healthcare Facilities
AEIC Association of Edison Illuminating Companies
ANSI American National Standards Institute
ASTM American Society of Testing Materials
AWS American Welding Society
AWWA American Water Works Association
CSA/USA Canadian Standards Association/USA
ICEA Insulated Conductors Engineers Association
IEEE Institute of Electrical and Electronics Engineers
IES Illuminating Engineering Society
NBFU National Board of Fire Underwriters
NEC National Electrical Code, NFPA 70
NECA National Electrical Contractors Association
NEMA National Electrical Manufactures' Association
NETA InterNational Electrical Testing Association
NFPA National Fire Protection Association
OSHA Occupational Safety and Health Act
UL Underwriter's Laboratories

E. Comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. Perform all electrical work in compliance with applicable safety regulations, including OSHA regulations. All safety lights, guards, and warning signs required for the performance of the electrical work shall be provided by the Contractor.

G. Obtain and pay for all permits, licenses and fees that are required by the governing authorities for the performance of the electrical work.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with other divisions for electrical work included in them but not listed in Division 26 or indicated on electrical Drawings.

B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any work covered by this Division.

C. Refer to Drawings and divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Make all offsets required to clear equipment, beams and other structural members, and to facilitate concealing conduit in the manner anticipated in the design.

D. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. Maintain an electrical foreman on the jobsite at all times to coordinate this work with other trades so that various components of the electrical systems is installed at the proper time, fits the available space, and allows proper service access to all equipment. Carry on the Work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.

F. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

A. The Drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

A. Refer to Division 01 and General Conditions for submittal requirements, in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain Henderson Engineer’s firm name or logo, nor shall they contain the Henderson Engineer’s seal and signature. They shall not be copies of Henderson Engineer’s work product. If the Contractor desires to use elements of such product, the license agreement for transfer of information at the end of this section must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before electrical construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contractor Administrator’s and Engineer’s designated representatives. Contractor shall allow for the Engineer review time as

specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

K. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.

1.8 SUBSTITUTIONS

A. Refer to Division 1 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:

1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:

    a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    c. Proposed substitution has received necessary approvals of the Authorities Having Jurisdiction.
    d. Same warranty will be furnished for proposed substitution as for specified Work.
    e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
    f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:

1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
2. No substitutions will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
3. If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.9 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet.

B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.

C. Contact the Architect for Architect's written authorization.

D. The following must be received before electronic drawing files will be sent:

1. Architect's written authorization
2. Engineer's release agreement form
3. Payment

1.10 QUALITY ASSURANCE

A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.

B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.

C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Contract Administrator, for Engineer’s review, and for the Owner’s use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Contract Administrator and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Contract Administrator’s and Engineer’s designated representatives.

1.12 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections of this Division

1.13 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the

Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Contract Administrator.

1.14 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Contract Administrator.

D. Be responsible for the safe storage of tools, material and equipment.

1.15 WARRANTIES

A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

C. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer’s standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.

D. Also warrant the following additional items:

1. All raceways are free from obstructions, holes, crushing, or breaks of any nature.
2. All raceway seals are effective.
3. The entire electrical system is free from all short circuits and unwanted open circuits and grounds.

E. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.

F. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.

G. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.16 TEMPORARY FACILITIES

A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, electricity, telephone, and internet. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.

1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees F. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.17 FIELD CONDITIONS

A. Conditions Affecting Work In Existing Buildings: The following project conditions apply:

1. The Drawings describe the general nature of remodeling to the existing building; however, visit the site prior to submitting bid to determine the nature and extent of work involved.
2. Schedule work in the existing building with the Owner.
3. Perform certain demolition work prior to the remodeling. Perform the demolition that involves electrical systems, Light fixtures, equipment, raceways, equipment supports or foundations and materials.
4. Remove articles that are not required for the new work. Unless otherwise indicated, remove each item removed during this demolition from the premises and dispose in accordance with applicable federal, state and local regulations.
5. Relocate and reconnect electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical equipment or materials are removed, cap unused raceways below the floor line or behind the wall line to facilitate restoration of finish.
6. Finish material will be installed under other divisions.
7. Obtain permission from the Contract Administrator for channeling of floors or walls not specifically noted on the Drawings.
8. Protect adjacent materials indicated to remain. For work specific to this Division, install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
9. 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, provide temporary services for affected areas.]

B. Conditions Affecting Excavations: The following project conditions apply:

1. Maintain and protect existing building services that transit the area affected by selective demolition.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

D. Use of explosives is not permitted.

E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

(Not Used)

A. REFER TO DIVISION 02 FOR EXCAVATION REQUIREMENTS.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

3.2 EXISTING CONDITIONS

A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new work.

B. Verify all actual existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.

3.3 EXISTING UTILITIES

A. Prepare and submit a schedule of anticipated utility outages indicating dates and duration. Schedule

B. Schedule and coordinate with the utility companies, Owner and with the Contract Administrator all connections to, relocation of, or discontinuation of normal utility services from any existing utility line. Include all premium time required for all such work in the bid.

C. Repair all existing utilities damaged due to construction operations to the satisfaction of the Owner or utility companies without additional cost.

D. Do not leave utilities disconnected at the end of a workday or over a weekend unless authorized by representatives of the Owner or Contract Administrator.

E. Make repairs and restoration of utilities before workers leave the project at the end of the workday in which the interruption takes place.

F. Include in bid the cost of furnishing temporary facilities to provide all services during interruption of normal utility service.

3.4 WORK IN EXISTING FACILITIES

A. The Drawings describe the general nature of remodeling to the existing facilities; however, visit the site prior to submitting a bid, to determine the nature and extent of work involved.

B. Schedule work in the existing facility with the Owner.

C. Certain demolition work shall be performed prior to the remodeling. Perform the demolition that involves electrical systems, fixtures, conduit, wiring, equipment, equipment supports or foundations and materials.

D. Remove all of these articles that are not required for the new work. Unless otherwise indicated, each item removed during this demolition shall be removed from the premises and disposed of in accordance with all state and local regulations.

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

1. Notify Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner's written permission.
3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.

F. Relocate and reconnect all electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical fixtures or equipment are removed, cap all unused raceways behind the floor line or wall line to facilitate restoration of finish, and, remove all existing wiring from abandoned raceways.

G. Finish materials are specified in other divisions.

H. Where removal of existing wiring interrupts electrical continuity of circuits that are to remain in use, provide necessary wiring, raceways, junction boxes, etc., to ensure continued electrical continuity.

I. Channel walls and floors as required to produce the desired result; however, obtain permission from the Contract Administrator for all channeling not specifically noted on the Drawings.

J. Provide new, typewritten card directory for distribution equipment (including but not limited to load centers, panelboards, switchboards and switchgear) where changes occur under this scope of work. Indicate exact loads served by each existing circuit breaker or switch.

3.5 PERMITS

A. Secure and pay for all permits required in connection with the installation of the Electrical Work. Arrange with the various utility companies for the installation and connection of all required utilities for this facility and pay all charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.6 TEMPORARY ELECTRICAL SERVICE AND WIRING

A. Provide 208Y/120 volt, three-phase, four-wire, temporary electrical service and temporary lighting system to facilitate construction.

B. In existing facilities, with Owner's approval, Contractor may utilize the existing electrical system as the source of temporary power. Coordinate the point of connection and method of connection to the existing system with the Owner's Representative.

C. Pay all charges made by the Electric Utility, with respect to installation and energy charges for temporary services.

D. Work for the temporary power shall consist of all labor and materials, including, but not limited to conduit, wiring, panelboards, fuse blocks, fused disconnecting switches, fuses, pigtails, receptacles, wood panel switch supports, and other miscellaneous materials required to complete the power system.

E. Install all temporary wiring in accordance with applicable codes, and maintain in an OSHA-approved manner.

F. Provide an adequate number of GFCI type power distribution centers, rated 208Y/120V, four-wire, and not less than 60A, with sufficient fuse blocks or breakers for lighting and hand tool circuits, 60A four-wire feeders, all mounted within pre-fabricated enclosures UL listed for this application or on suitable wood panels bolted to columns or upright wood supports as required.

G. Install circuits to points on each level of each building so that service outlets can be reached by a 50-foot extension cord for 120V power and a 100-foot extension cord for 208V power (or as required by OSHA or local authorities).

H. Provide one lighting outlet per 30 linear feet of corridor and at least one light in each room and for every 800 square feet of floor area. Temporary lighting shall comply with OSHA requirements.

I. If additional service is required for cranes, electrical welders or for electric motors over 1/2 HP per unit, such additional service shall become the responsibility of the trade involved.

J. When the permanent wiring for lighting and power is installed, with approval of the Contract Administrator and Owner, the permanent system may be used, provided the Contractor assumes full responsibility for all electrical material, equipment, and devices contained in the systems and provided that roof drainage system and roofing are complete.

K. When directed by the Contract Administrator, remove all temporary services, lighting, wiring and devices from the property.

3.7 SELECTIVE DEMOLITION

A. Refer to Division 01, Division 02, and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.

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

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

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

E. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete raceways, fittings, supports and specialties, equipment, wiring, controls, fixtures, and insulation:

    a. Raceways and outlets embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Cut embedded raceways to below finished surfaces, seal, and refinish surfaces as specified or as indicated on the Architectural Finish Drawings. Remove materials above accessible ceilings. Cap raceways allowed to remain.
    b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 26.

3.8 ACCESS TO EQUIPMENT

A. Locate all pull boxes, junction boxes and controls so as to provide easy access for operation, service inspection and maintenance. Provide an access door where

equipment or devices are located above inaccessible ceilings. Refer to Division 26 Section “Common Work Results for Electrical”.

B. Maintain all code required clearances and clearances required by manufacturers.

3.9 PENETRATIONS

A. Unless otherwise noted as being provided under other divisions, provide sleeves, box frames, or both, for openings in floors, walls, partitions and ceilings for all electrical work that passes through construction. Refer to Division 26 Section “Common Work Results for Electrical”.

B. Provide sleeves, box frames, or both, for all conduit, cable, and busways that pass through masonry, concrete or block walls.

C. The cutting of new and/or existing construction will not be permitted except by written approval of the Contract Administrator.

3.10 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02 and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this division. Excavation shall be in conformance with applicable Divisions and sections of the Specifications.

C. Restore roads, alleys, streets and sidewalks damaged during this work to the satisfaction of Authorities Having Jurisdiction.

D. Do not excavate trenches close to walks or columns without prior consultation with the Contract Administrator.

E. Erect barricades around excavations, for safety, and place an adequate number of amber lights on or near the work and keep those burning from dusk to dawn. Be responsible for all damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.

F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Tanks and Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of one inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches for electrical installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of six to nine inches clearance on both sides of raceway and cables.
2. Excavate trenches to depth indicated or required for raceway and cables to establish slope, away from buildings and indicated elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which raceway and cables can be installed, tested, and the trench backfilled within the same day.

4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceway and cables. Provide a minimum of six inches of stone or gravel cushion between rock bearing surface and raceway and cables.
5. Excavate trenches for raceway, cables, and equipment with bottoms of trench to accurate elevations for support of raceway and cables on undisturbed soil.

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

N. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under raceway and cables, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For raceway and cables less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of raceway and cables, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
5. Other areas use excavated or borrowed materials.

O. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

P. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

1. For vertical and diagonal raceway installations, thoroughly support raceways from permanent structures or undisturbed earth at no less that 10-foot intervals, while placing backfill materials, so that raceways are not deflected, crushed, broken, or otherwise damaged by the backfill placement.

Q. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

R. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

S. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

    a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

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

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

3.11 CUTTING AND PATCHING

A. Provide all necessary cutting of walls, floors, ceilings and roofs for work under this Division.

B. Cut no structural member without permission from Contract Administrator.

C. Patch around all openings to match adjacent construction.

D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Contract Administrator.

3.12 PAINTING

A. Refer to Division 09 Section “Painting” for painting requirements.

B. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.

C. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer’s instructions for pre-cleaning surfaces and application.

D. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.

E. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

3.13 CLEANING

A. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to final inspection, make a final cleanup of dirt and refuse resulting from the Work and assist in making the premises broom clean. Clean all material and equipment installed under this Division.

C. Remove dirt, dust, plaster, stains, and foreign matter from all surfaces.

D. Touch up and restore damaged finishes to their original condition.

3.14 ADJUSTING, ALIGNING AND TESTING

A. Adjust, align and test all electrical equipment furnished and/or installed under this Division.

B. Check motors for alignment with drive and proper rotation, and adjust as required.

C. Check and test protective devices for specified and required application, and adjust as required.

D. Check, test and adjust adjustable parts of all light fixtures and electrical equipment as required to produce the intended performance.

E. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.

F. After completion, perform tests for continuity, unwanted grounds, and insulation resistance in accordance with the requirements of NFPA 70 and NETA.

G. Be responsible for the operation, service and maintenance of all new electrical equipment during construction and prior to acceptance by the Owner of the complete project under this Contract. Maintain all electrical equipment in the best operating condition including proper lubrication.

H. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor or both.

I. Maintain service and equipment for all testing of electrical equipment and systems until all work is approved and accepted by the Owner.

J. Keep a calibrated voltmeter and ammeter (true RMS type) available at all times. Provide service for test readings when and as required.

K. Refer to individual sections for additional and specific requirements.

3.15 START-UP OF SYSTEMS

A. Prior to start-up of electrical systems, check all components and devices, lubricate items appropriately, and tighten all screwed and bolted connections to manufacturers' recommended torque values using appropriate torque tools.

B. Each power, lighting and control circuit shall be energized, tested and proved free of breaks, short-circuits and unwanted grounds.

C. Adjust taps on each transformer for rated secondary voltages.

D. Balance all single phase loads at each panelboard, redistributing branch circuit connections until balance is achieved to plus or minus 10 percent.

E. Replace all burned-out lamps. Replace the lamps of all light fixtures that use incandescent, halogen or quartz lamp sources that are installed as part of the finished building, but are used by the Contractor during construction, with new lamps of appropriate type and wattage prior to turning the facility over to the Owner.

F. After all systems have been inspected and adjusted, confirm all operating features required by the Drawings and Specifications and make final adjustments as necessary.

G. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.

H. At the time of final review and tests of the power and lighting systems, all equipment and system components shall be in place and all connections at panelboards, switches, circuit breakers, and the like, shall be complete. All fuses shall be in place, and all circuits shall be continuous from point of service connections to all switches, receptacles, outlets, and the like.

3.16 TEST REPORTS

A. Perform tests as required by these Specifications and submit the results in the operations and maintenance manuals. The tests shall establish the adequacy, quality, safety, and reliability for each electrical system installed. Notify the Contract Administrator and Engineer two working days prior to each test.

B. For specific testing requirements of special systems, refer to the Specification section that describes that system.

C. Upon completing each test, record the results, date and time of each test and the conditions under which the test was conducted. Submit to the Contract Administrator, for Engineer's review, in duplicate, the test results for the following electrical items:

1. Building service entrance voltage and amperes at each phase.
2. Electrical service grounding conditions and grounding resistance.
3. Proper phasing throughout the entire system.
4. Voltages (phase-to-phase and phase-to-neutral) and amperes at each phase for each panelboard, switchboard, and the like.
5. Phase voltages and amperes at each three-phase motor.
6. Test all wiring devices for electrical continuity and proper polarity of connections.

D. Promptly correct all failures or deficiencies revealed by these tests as determined by the Engineer.

3.17 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:

1. Submit complete Operation and Maintenance Data.
2. Submit complete Record Drawings.
3. Perform all required training of Owner's personnel.
4. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
5. Perform start-up tests of all systems.
6. Remove all temporary facilities from the site.

7. Comply with all requirements for Substantial Completion in the Division 01 and General Conditions.

B. Request in writing a review for Substantial Completion. Give the Contract Administrator at least seven (7) days notice prior to the review.

C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, he shall reimburse the Contract Administrator and Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Contract Administrator will prepare a “final list” of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the “final list” shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

_____	_____	_____
Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

_____	_____	_____
Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

_____	_____	_____
Contractor Acceptance Signature	Date	Company
_____	_____	_____
Owner Acceptance Signature	Date	Company
_____	_____	_____
Architect Acceptance Signature	Date	Company
_____	_____	_____
Engineer Acceptance Signature	Date	Company

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes limited scope general construction materials and methods, electrical equipment coordination, and common electrical installation requirements as follows:

1. Access doors in walls, ceilings, and floors for access to electrical materials and equipment.
2. Sleeves and seals for electrical penetrations.
3. Joint sealers for sealing around electrical materials and equipment, and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
4. Sealing penetrations through noise critical spaces.

1.2 DEFINITIONS

A. The following abbreviations apply to this and other Sections of these Specifications:

1. AHJ: Authority(ies) having Jurisdiction
2. ATS: Acceptance Testing Specifications
3. EPDM: Ethylene-propylene-diene monomer rubber
4. MC: Metal Clad
5. NBR: Acrylonitrile-butadiene rubber
6. NRTL: Nationally Recognized Testing Laboratory
7. PCF: Pounds per Cubic Foot

B. The following definitions apply to this and other Sections of these Specifications:

1. Homerun: That portion of an electrical circuit originating at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first load.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.
4. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":

1. Product data for the following products:

   a. Sleeve seals.
   b. Through and membrane penetration firestopping systems.

2. Shop drawings for:

   a. Detailed fabrication drawings of access panels and doors.

3. Through and Membrane Penetration Firestopping Systems Product Schedule: Provide UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.

   a. Where Project conditions require modification to qualified testing and inspecting agency's illustrations for a particular firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
   b. Qualifications data for testing agency.

4. Record Drawings: Submit Record Drawings as required by Division 1 and Division 26

   a. Accurately record actual locations of firestopped penetrations and access panel/door locations. Indicate dimensions from fixed structural elements.

1.5 NOISE CRITICAL SPACES

A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces that will require application of sound attenuating measures and acoustical sealants.

1. Offices
2. Conference Rooms

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 ACCESS TO EQUIPMENT

A. Available Manufacturers:

1. Bar-Co., Inc.
2. Elmdor Stoneman.
3. JL Industries
4. Jay R. Smith Mfg. Co.
5. Karp Associates, Inc.
6. Milcor
7. Nystrom Building Products
8. Wade
9. Zurn

B. Access Doors:

1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Electrical Systems” for labeling of access doors.

2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Contract Administrator prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

    a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
    b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
    c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.

7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

    a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

8. Locking Devices: Flush, screwdriver-operated cam locks.
9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.3 SLEEVES

A. Steel sleeves for raceways and cables

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

B. Cast iron wall pipe sleeves for raceways and cables

1. Manufacturers

    a. Josam Mfg. Co.
    b. Smith (Jay R) Mfg. Co.
    c. Tyler Pipe/Wade Div.; Subs of Tyler Corp.

d. Watts Industries, Inc.
e. Zurn Industries, Inc.; Hydromechanics Div.

2. Cast-iron sleeve with integral clamping flange with clamping ring, and nuts for membrane flashing.

a. Underdeck Clamp: Clamping ring with setscrews.

3. Sleeves for rectangular openings: Galvanized sheet steel with minimum 0.052- or 0.138- inch thickness as indicated and of length to suit application.
4. Coordinate sleeve selection and application with selection and application of firestopping to be used.

2.4 SEALANTS

A. SLEEVE SEALS

1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
2. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. O-Z/Gedney
e. Pipeline Seal and Insulator, Inc.

3. Sealing Elements: Interlocking or solid sealing links shaped or pre-drilled to fit surface of cable or raceway. Include type and number required for material and size of raceway or cable.

a. EPDM
b. NBR
c. Neoprene

4. Pressure Plates: Include two for each sealing element. For multi-phase circuits, use slotted pressure plates if metal.

a. Plastic
b. Carbon steel
c. Stainless steel
d. PVC-coated steel

5. Connecting Bolts and Nuts: of length required to secure pressure plates to sealing elements. Include one for each sealing element.

a. Carbon steel with corrosion-resistant coating
b. Stainless steel

B. JOINT SEALERS

1. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
2. Colors: As selected by the Contract Administrator from manufacturer's standard colors.
3. Elastomeric Joint Sealers: Provide the following types:

    a. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
    b. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
    c. Products: Subject to compliance with requirements, provide one of the following:

        1) One-Part, Nonacid-Curing, Silicone Sealant:

            a) "Dow Corning 790," Dow Corning Corp.
            b) "Dow Corning 795," Dow Corning Corp.
            c) "Silglaze N SCS 2801," General Electric Co.
            d) "Silpruf SCS 2000," General Electric Co.
            e) "864," Pecora Corp.
            f) ."Omniseal," Sonneborn Building Products Div
            g) "Spectrem 1," Tremco, Inc.
            h) "Spectrem 2," Tremco, Inc.

        2) One-Part, Mildew-Resistant, Silicone Sealant:

            a) "Dow Corning 786," Dow Corning Corp.
            b) "Sanitary 1700," General Electric Co.
            c) "898 Silicone Sanitary Sealant," Pecora Corp.
            d) "OmniPlus," Sonneborn Building Products Div.
            e) "Tremsil 600 White," Tremco Corp.

4. Acrylic-Emulsion Sealants: One-part, non-sagging, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) "Chem-Calk 600," Bostik

2) "AC-20," Pecora Corp.
3) "Sonolac," Sonneborn Building Products Div.
4) "Tremflex 834," Tremco, Inc.

C. FIRESTOPPING

1. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, by Underwriters' Laboratories, Inc., or other NRTL acceptable to AHJ.

a. Available Manufacturers:

1) Hilti, Inc.
2) RectorSeal.
3) Specified Technologies Inc.
4) 3M Corp.
5) United States Gypsum Company.

D. ACOUSTICAL SEALANTS sealants

1. Foam Backer Rod: Closed cell polyethylene suitable for use as a backing for non-hardening sealant.
2. Non-Hardening Penetration Sealant: Non-hardening polysulphide type, Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
3. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 PCF (40 kg/m3).

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping”.

C. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)

D. Comply with NECA 1.

E. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise.

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

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

H. Right of Way: Yield to raceways and piping systems installed at a required slope.

3.2 ACCESS DOORS

A. Coordinate with architectural finishes to set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

C. Label all access doors with a nameplate as described in Division 26 Section “Identification for Electrical Systems”.

3.3 SLEEVES AND SLEEVE SEALS

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

B. Provide sleeves for required openings in all concrete and masonry construction and fire, smoke, or both, partitions, for all electrical work that passes through such construction. Coordinate with all other trades and divisions to dimension and lay out all such openings.

C. Only those openings specifically indicated on the Architectural or Structural Drawings will be provided under other divisions.

D. New Construction:

1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support raceway penetrations.

E. Construction in Existing Facilities:

1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Contract Administrator, Owner, or both.

Seal sleeves into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Contract Administrator.

F. 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. Do not cut or core drill new construction without written approval from the Contract Administrator and Structural Engineer.

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

H. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

I. 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.

J. Install pipe and rectangular sleeves in above-grade walls and slabs, where penetrations are not subject to hydrostatic water pressures. Ensure that drip ring is fully encased and sealed within the wall or slab.

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

L. Extend sleeves installed in floors 2 inches above finished floor level.

M. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed; in which case, size sleeves as recommended by the seal manufacturer.

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

O. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint

P. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

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

R. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (or larger, if required by the seal manufacturer) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

S. Above Grade Concrete or Masonry Penetrations

1. Provide sleeves for cables or raceways passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:

    a. Install schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
    b. Install galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 0.138 inches.
    c. Install galvanized sheet metal for rectangular sleeves
    d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.

2. Seal elevated floor, exterior wall and roof penetrations watertight and weather tight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

T. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between sleeve and cable or raceway. Provide mechanical sleeve seal.

1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
2. Inspect installed sleeve and sleeve-seal installation for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.

U. Elevated Floor Penetrations of waterproof membrane:

1. Provide cast-iron wall pipes for sleeves. Size wall pipe for minimum ½" annular space between wall pipe and cable or raceway.
2. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.
3. Secure waterproof membrane flashing between clamping flange and clamping ring.
4. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.

V. Interior Foundation Penetration: Provide sleeves for horizontal raceway passing through or under foundation. Sleeves shall be cast iron soil pipe two normal pipe sizes larger than the pipe served.

W. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and cable or raceway, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

X. Exterior Wall Penetrations: Seal annular space between sleeve and raceway or duct, using joint sealant for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.

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

Z. Sleeve-Seal Installation

1. Install sleeve seals for all underground raceway penetrations through walls at elevations below finished grade. Additionally, install seals inside raceways, after conductors or cables have been installed, in all raceway penetrations through walls at elevations below finished grade.
2. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

AA. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade and above grade where installed to seal against hydrostatic pressure.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire/smoke-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.5 JOINT SEALERS

A. Preparation for Joint Sealers

1. Clean surfaces of penetrations, sleeves, or both, immediately before applying joint sealers, to comply with recommendations of joint sealer manufacturer.
2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

B. Application of Joint Sealers

1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

a. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
b. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

2. Tooling: Immediately after sealant application and prior to time shining or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical raceways penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.6 ACOUSTICAL PENETRATIONS

A. Do not allow direct contact of raceways with shaft walls, floor slabs and/or partitions. Sleeve, pack and seal airtight with foam rod, non-hardening sealant and/or packing material, as described herein, for all penetrations by raceway, through surfaces that encompass or are between noise critical spaces. Seal and pack with caulking for the full depth of the penetration all openings around raceways in the structure surrounding the electrical equipment and surrounding noise-critical spaces. This includes all slab penetrations and penetrations of noise critical walls.

B. Where a raceway passes through a wall, ceiling or floor slab of a noise critical space, cast or grout a metal sleeve into the structure. The internal diameter or dimensions of the sleeve shall be 2 inches larger than the external diameter or dimensions of the raceway passing through it. After all of the raceways are installed in that area, check the clearances and correct, if necessary, to within 1/2-inch. Pack the voids full depth with packing material sealed at both ends, 1-inch deep, with non-hardening sealant backed by foam rod.

END OF SECTION

SECTION 260502 - EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes limited scope for electrical connections to equipment specified under other sections or divisions, or furnished under separate contracts or by the Owner.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this contract.

B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and rough-in requirements based on shop drawings.

D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

E. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.

B. Product data for the following products for:

1. Special connectors

2. Special conductors or cable assemblies.

C. Shop drawings for:

3. Detailing electrical characteristics, wiring diagrams, fabrication and installation for wiring systems.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories:

4. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.

5. Marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 CORDS AND CAPS

A. Attachment Plugs: Conform to NEMA WD 1.

B. Configuration: NEMA WD 6, matching receptacle configuration at outlet provided for equipment, or as required by the equipment manufacturer.

C. Cord: See Paragraph “Flexible Cords” in Division 26 Section “Low-voltage Electrical Power Conductors and Cables”.

D. Provide cord size suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

1.2 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s instructions.

3.2 ELECTRICAL DEVICES

A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control devices) specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

3.3 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturers' instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.

C. Make wiring connections using conductors and cable with insulation suitable for temperatures encountered in heat producing equipment.

D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated on the Drawings.

E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

F. Provide interconnecting conduit and wiring between devices and equipment where indicated on the Drawings.

3.4 HVAC EQUIPMENT

A. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, will be provided by the equipment supplier, unless otherwise noted.

B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.

C. Provide all control and interlock wiring for all equipment that is not included within the responsibility of Division 22 or 23.

3.5 DOOR OPERATORS AND HARDWARE

A. Provide electrical connections to automatic entry doors, automatic corridor doors, electrically held door latches, remote release doors, and all other required electrical connections for door systems included in other sections of these specifications.

B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.

C. Provide all control wiring and conduit for all equipment that is not included within the responsibility of the door hardware installer. Provide connection from junction boxes to the door operators or hardware and from door operators to actuation devices as required. Install key operated switches, push pad switches, and other electrically controlled door operation devices furnished by other divisions within this contract.

D. Provide fire alarm devices and wiring as required for proper operation of door systems in accordance with the NFPA codes.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Conductors, cables, and cords rated 600V and less.
2. Connectors and terminations rated 600V and less.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for sleeves and seals for electrical penetrations.

C. Division 26 Section “Grounding and Bonding for Electrical Systems” for conductors and connectors for grounding systems.

D. Division 26 Section “Equipment Wiring Systems” for electrical connections to equipment specified under other Sections, Divisions, or furnished by the Owner.

1. Division 28 Section “Digital, Addressable Fire-Alarm System” for fire alarm wiring.

E. Division 23 Section “Direct-Digital Control for HVAC” for temperature control wiring.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:

1. Product data for the following products:

a. Metal Clad (MC) cable and fittings.

B. Qualification Data: For testing agency.

C. Field Quality-Control Test Reports: From Contractor.

1.4 ABBREVIATIONS AND DEFINITIONS

A. The following abbreviations apply to this and other Sections of these specifications:

1. MC: Metal Clad
2. NBR: Acrylonitrile-butadiene rubber

B. The following definitions apply to this and other Sections of these Specifications:

1. HOMERUN: That portion of an electrical circuit beginning at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is allowed to be utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first (most upstream) load.

1.5 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

C. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.

D. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
2. Marked for intended use.

E. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 CONDUCTORS AND CABLES

A. General

1. Available Manufacturers:

a. AFC Cable Systems, Inc.
b. Alan Wire
c. Cerrowire
d. Colonial Wire & Cable
e. Encore Wire Corporation
f. General Cable
g. Northern Cables Inc.
h. Okonite Company
i. Southwire Company

2. Conductor Material: Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL Standards 44 or 83, as applicable; [stranded conductor][solid conductor for No. 10 AWG and smaller; concentric, compressed stranded for No. 8 AWG and larger] [and] [stranded for all flexible cords, cables, and control wiring][or as noted otherwise below].
3. Conductor Insulation Types: Type THHN/THWN-2 and/or XHHW-2 complying with ICEA S-95-658/NEMA WC70 [or as noted otherwise below].
4. Sizes of conductors and cables indicated or specified are American Wire Gage (Brown and Sharpe).
5. Unless indicated otherwise, special purpose conductors and cables, such as low voltage control and shielded instrument wiring, shall be as recommended by the system equipment manufacturer.
6. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

B. Metal Clad Cable, Type MC – shall not be used on this project.

C. Nonmetallic Sheathed Cable

1. NM or NMC cable:

a. 600V, THHN- or XHHW-insulated conductors (2, 3 or 4 as indicated on Drawings or as required); color code: ICEA Method 1, with green insulated or bare grounding conductor; color-coded PVC-jacket for quick identification of conductor size; UL Standards 44 or 83 (as applicable), and 719, NFPA 70 Article 334.

D. Single Conductors

1. 600V, THW-THHN/THWN-2 and/or XHHW-insulated conductors.

Flexible Cords

2. 600V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant [black][yellow] jacket, extra-hard-usage; Type [SEO,][SO,] [or] [STO] for indoor dry and damp locations; [SEOW,][SOW,] [or] [STOW] for damp, wet, and outdoor locations[; or as required by the manufacturer of the equipment to which the cords are connected].
3. 300V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant [black][yellow] jacket, hard-usage; Type [SJEO,][SJO,] [or] [SJTO] for indoor dry locations; [SJEOW,][SJOW,] [or] [SJTOW] for damp, wet, and outdoor locations[; or as required by the manufacturer of the equipment to which the cords are connected].

E. Control Wiring

1. [Refer to Division 23 Section “Direct-Digital Control for HVAC”]
2. Unless otherwise noted, all control wiring will be the responsibility of the Section or Division in which the control system is specified.

F. Connectors

1. [Available] Manufacturer[s]:

a. AMP; Tyco
b. FCI-Burndy
c. Gould
d. Ideal Industries, Inc.
e. Ilsco
f. NSi Industries, Inc.
g. O-Z/Gedney
h. Panduit
i. Thomas and Betts
j. 3-M Electrical Products Division

2. Compression connectors for conductors No. 8 AWG and larger: Long-barreled, UL 486-listed, [tinned][bare] copper, circumferential compression type (Burndy "Hylug", or equal), insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.

    a. Termination fittings: [1-] [or] [2-]hole pad and inspection port.

3. Mechanical connections for conductors No. 8 AWG and larger: UL-listed, [tinned][bare] [copper] [and/or] [tinned aluminum], dual-rated, mechanical type, insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.

    a. Termination fittings: [1-] [or] [2-]hole pad and inspection port.

4. Connectors for solid conductors No. 10 AWG and smaller: Insulated winged wire nuts. Color-coded for size, except use green only for grounding connections.
5. Connectors for stranded conductors No. 10 AWG and smaller: Tinned copper, insulated-sleeve, compression type, UL-listed, with wire insulation grip. Terminations: [flanged fork][ring]-tongue type.
6. Connectors and terminations for aluminum conductors and cables No. 1 and larger: UL 486B listed and marked AL7CU for 75 deg C rated conductors and AL9CU for 90 deg C rated conductors.

PART 3 - EXECUTION

3.1 CONDUCTORS AND CABLES

A. General:

1. Unless otherwise indicated on the Drawings on in other Sections, install all conductors in raceway. Install continuous conductors between outlets, devices and boxes without splices or taps. Do not pull connections into raceways. Leave at least 8 inches of conductor at outlets for fixture or device connections.
2. Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
3. Use pulling means, including fish tape, cable, rope, and basket weave conductor/cable grips that will not damage conductors/cables or raceway.
4. Electrical conductor and cable work is schematically represented on the Drawings. Unless otherwise indicated, conductor sizes shown on the Drawings are based on not more than three single current-carrying conductors in a raceway in free air. Current ratings are based on copper at 75 degrees C temperature rating for all power circuits. Modify raceway and conductor sizing as may be necessitated by any deviation from these conditions. Do not decrease the indicated conductor size due to the use of conductors having a temperature rating of 90 degrees C.

5. Conductor sizes shown are minimum based on code requirements, voltage drop, and/or other considerations. Where approved by the Engineer and at no extra cost to the Owner, larger conductor sizes may be installed at Contractor's option in order to utilize stock sizes, provided raceway sizes are increased where necessary to conform with NFPA 70 (determine the effect of the use of larger conductors on the short circuit current ratings of the electrical equipment, and provide increased short circuit current rated equipment as required).
6. Where parallel conductors are shown, install each set of conductors in separate raceways of essentially the same length.
7. Seal around cables penetrating fire-rated elements according to [Part 2 of this Section][Division 07 Section "Penetration Firestopping"].
8. Identify and color-code conductors and cables according to [Part 2 of this Section][Division 26 Section “Identification for Electrical Systems"].
9. Wiring at Outlets: Install conductors at each outlet with at least [6 inches][12 inches] of slack.
10. Common or Shared Neutrals are not allowed unless shown on the plans or specifically noted to be allowed.
11. Multi-wire branch circuits (i.e., shared neutral) shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single pole breakers with a handle tie are two example
12. When multiple home runs are combined into a single raceway such that the number of conductors exceeds four (conductor count is made up of any combination of phase and neutral conductors), the following restrictions apply, which are in addition to those in NFPA 70:

    a. Emergency Power Circuits – includes all circuits covered under Articles 700, 701 and 702.

        1) Maximum of eight conductors in a single raceway. Minimum raceway size: ¾-inch. Do not install any other type of circuit in this raceway.
        2) Only 15A and 20A branch circuit homeruns may be combined into one raceway.

    b. Normal or Non-Essential circuits.

        1) Maximum of 16 conductors in a single raceway. For up to eight conductors in a raceway, minimum raceway size: 3/4 inch. For greater than eight conductors, minimum raceway size: 1 inch. Do not install any other type of circuit in this raceway.
        2) The minimum wire size for all conductors in this raceway: No. 10 AWG.
        3) Only 15A and 20A branch circuit homeruns may be combined into one raceway.

    c. GFCI-protected circuits.

        1) Do not use multi-conductor circuits, with a shared neutral, for any GFCI circuit breaker or receptacle circuit.

d. Isolated Ground (IG) Circuits:

1) Do not use multi-conductor or MC cables.
2) Do not share neutrals between separate circuits.
3) Do not share the isolated grounding conductor with more than one device (i.e., each device on an IG circuit shall have its own dedicated IG conductor back to the branch panelboard IG bus).
4) The equipment grounding conductor may be shared between IG circuits sharing a common raceway.

13. For branch circuits fed from GFCI circuit breakers, limit the one-way conductor length to 100 feet between the panelboard and the most remote receptacle or load on the GFCI circuit.
14. Where the number of conductors for branch circuits is not shown on the Drawings, determine the number of conductors in accordance with NFPA 70. Provide adequate conductors so as to allow performance of all functions of the device.
15. Provide all conductors with 600V insulation of the following types, unless otherwise noted on the Drawings or in these Specifications:

a. Wet or dry locations, in raceways:

1) Feeders and branch circuits: Type THWN, THHN/THWN-2, or XHHW.
2) Conductors No. 6 AWG and smaller: Types THWN or THHN/THWN-2.

b. Fluorescent light fixtures or conductors within three feet of high temperature equipment such as heaters: Type THHN, XHHW, or higher temperature insulation as required for the use.

B. Type NM or NMC Cables:

1. When permitted for use by these documents, do not install NM or MNC cables above suspended ceilings in commercial facilities.

C. Flexible Cords

1. Refer to Division 26 Section, ""Equipment Wiring Systems", for electrical connections to equipment.

D. Control Wiring

1. Unless otherwise indicated on the Drawings or in other sections, install all control wiring in raceway, regardless of voltage. A qualified Electrician shall install all control wire operating at 120V nominal and above. Control wiring operating at less than 120V (e.g., 12V and 24V) may be installed under the Division furnishing it.
2. Open wiring in air-handling plenums: UL listed and classified for use in air plenums without raceway. Where indicated on the Drawings or specified, and permitted by local codes, only cable for communication or fire alarm systems and low voltage control wiring may be installed without raceways.

E. Connections:

1. Apply a zinc based, anti-oxidizing compound to connections.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
3. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
4. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
5. Use only resin pressure splices and splicing kits that totally encapsulate the splice for splices in underground junction boxes. Arrange the splicing kit to minimize the effects of moisture.
6. Connect conductors No. 6 AWG and larger to panelboards and apparatus by means of approved mechanical lugs or compression connectors.
7. Do not use terminals on wiring devices to feed through to the next device.

3.2 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:

B. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

C. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements. Test all wiring prior to energizing to ensure that it is free from unintentional grounds and shorts, is properly phased, and that all connectors are tight.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3. Certify compliance with test parameters.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. This Section includes:

1. Grounding Conductors
2. Connector Products
3. Grounding Electrodes
4. Ground Bars
5. Equipotential Grounding System
6. Miscellaneous Grounding Materials and Products

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this section.

B. Division 26 Section "Low-voltage Electrical Power Conductors and Cables” for insulated conductors.

C. Division 26 Section “Raceway and Boxes for Electrical Systems” for raceways.

D. Division 26 Section "Lightning Protection for Structures" for additional grounding and bonding materials.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:

1. Product data for the following products:

a. Electrodes, mechanical and compression connectors, and exothermic connectors .

1.4 DEFINITIONS

A. The following apply to this and other Sections of these Specifications:

1. EMT: Electrical metallic tubing.
2. ENT: Electrical nonmetallic tubing.
3. FMC: Flexible metal conduit.
4. IMC: Intermediate metal conduit.
5. LFMC: Liquidtight flexible metal conduit.
6. LFNC: Liquidtight flexible nonmetallic conduit.
7. RMC: Rigid Metal Conduit
8. GRS: Galvanized Rigid Steel Conduit
9. RAC: Rigid Aluminum Conduit
10. RNC: Rigid nonmetallic conduit.
11. PSF: Pounds per Square Foot

1.5 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Test Equipment Suitability and Calibration: Comply with NETA ATS (current version), "Suitability of Test Equipment" and "Test Instrument Calibration."

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

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

D. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
2. Marked for intended use.
3. Comply with UL 467.

E. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

F. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

G. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 GROUNDING CONDUCTORS, CONNECTORS, AND ELECTRODES:

A. Available Manufacturer:

1. Apache Grounding/Erico Inc.
2. Boggs, Inc.
3. Chance/Hubbell.
4. Copperweld Corp.
5. Dossert Corp.
6. Erico Inc.; Electrical Products Group.
7. FCI/Burndy Electrical.
8. Galvan Industries, Inc.
9. Harger Lightning Protection, Inc.
10. Hastings Fiber Glass Products, Inc.
11. Heary Brothers Lightning Protection Co.
12. Ideal Industries, Inc.
13. ILSCO.
14. Kearney/Cooper Power Systems.
15. Korns: C. C. Korns Co.; Division of Robroy Industries.
16. Lightning Master Corp.
17. Lyncole XIT Grounding.
18. O-Z/Gedney Co.; a business of the EGS Electrical Group.
19. Panduit, Inc
20. Raco, Inc.; Division of Hubbell.
21. Robbins Lightning, Inc.
22. Salisbury: W. H. Salisbury & Co.
23. Superior Grounding Systems, Inc.
24. Thomas & Betts, Electrical.

2.3 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Common Work Results for Electrical."

B. Material: Aluminum, copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Bare, stranded, unless otherwise indicated.

F. Underground Conductors:Tinned copper conductor, No. 2/0 insert value AWG minimum stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (wide and 1/16 inch thick.

I. Aluminum Bonding Conductors: As follows:

1. Bonding Cable: 10 strands of No. 14 AWG aluminum conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded aluminum conductor.
3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches wide and 1/16 inch thick.

J. Ground Conductor and Conductor Protector for Wood Poles: As follows:

1. No. 4 AWG minimum, soft-drawn copper conductor.
2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.

K. Grounding Bus: UL & cUL Listed to UL467 & C22.2 respectively, pre-drilled per TIA/EIA Standard 607, bare, 1/4 inch thick, electrolytic, tough pitch copper bar, length and width as indicated on the Drawings; insulators and standoffs as specified in Paragraph "Ground Bars" below.

2.4 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors

1. Compression Connectors: Burndy Hyground, or equal, permanent, pure, wrought copper, meeting ASTM 8 1 87, essentially the same as the conductors being connected; clearly and permanently marked with the information listed below:

   a. Company symbol and/or logo.
   b. Catalog number.
   c. Conductors accommodated.
   d. Installation die index number or die catalog number is required.
   e. Underwriters Laboratories "Listing Mark:".
   f. The words "Suitable for Direct Burial" or, where space is limited, "Direct Burial" or "Burial" per UL Standard ANSI/UL467 (latest revision).

2. Cast connectors: copper base alloy according to ASTM B 30 (latest revision).

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.5 GROUNDING ELECTRODES

A. Ground Rods: UL-listed:

1. Copper-clad steel; bonded copper electrolytically-applied to minimum thickness of 10 mils.
2. Hot-dip galvanized steel; minimum zinc thickness specified per ASTM A-123
3. Stainless steel; Type 304.

4. Size: 3/4 inch by 10 feet. Provide sectional types when longer rods are indicated.

B. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a bare conductor sized, at a minimum, for the size of the connecting grounding electrode conductor.

C. Ground Plates: UL-listed, rectangular, bare solid copper plate; minimum 0.032-inch thick.

2.6 GROUND BARS

A. Rectangular Ground Bars: UL & cUL Listed to UL467 & C22.2 respectively, pre-drilled per TIA/EIA Standard 607, bare, 1/4 inch thick, electrolytic, tough pitch copper bar, length and width as indicated on the Drawings.

B. Supports: Minimum of two each 1-1/2-inch insulators and 1-inch stainless steel offset mounting brackets.

2.7 EQUIPOTENTIAL GROUNDING SYSTEM

A. Operating and Delivery room ground modules: Post-Glover #RRP4-26 with 6 ground jacks, 2 twist locks receptacles and ground bus in a single housing with stainless steel trim.

B. Ground modules in locations, other than Operating and Delivery rooms: Post-Glover #GJP-3-06 with 6 ground jacks and a ground bus in a single housing with stainless steel trim.

2.8 MISCELLANEOUS

A. Test Wells:

1. Traffic Areas: Polymer concrete reinforced with heavy weave fiberglass; H-20 load rating; minimum 24 inches deep.
2. Non-traffic Areas: High density polyethylene; 350 PSF minimum load rating; minimum 10.25 inches deep.

B. Ground Enhancing Backfill: Provide low-resistivity, ground-enhancing backfill material recommended by the electrode manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine areas and conditions under which electrical grounding connections are to be made and notify the Architect/Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with Work until unsatisfactory conditions have been corrected.

B. Provide all materials, labor and equipment for an electrical grounding system in accordance with applicable portions of the NEC and NECA. Coordinate electrical work as necessary to interface installation of electrical grounding systems with other work.

C. Accomplish grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded for both temporary and permanent construction.

3.2 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In branch circuit and feeder raceways, use insulated equipment grounding conductors.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated on the Drawings.

1. Use insulated spacers and mounting brackets, and support from wall 8 feet above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

D. Underground Grounding Conductors: Bury at least 24 inches below grade, or 6 inches below the official frost line, whichever is greater, or when crossing a duct bank, bury 12 inches above duct bank.

3.3 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and branch circuits.

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

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Feeders and branch circuits installed in non-metallic raceways.

D. Separately Derived Systems: Bond the derived neutral (grounded) conductor of all separately derived system (e.g., transformers, generators, UPS) to the nearest available grounding electrode, or back to the service grounding electrode if no approved

electrodes are readily available. Size the grounding electrode conductor and bonding jumpers as indicated on the Drawings or as required by NFPA 70, whichever is larger.

E. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

F. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components. On water heaters, bond metal hot and cold water pipes together, across the heater tank.

H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a ground bar. Size: 1/4-by-2-by-12-inch or as indicated on Drawings.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

I. Metal Poles Supporting Outdoor Luminaires: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

J. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in PVC conduit.

3.4 COUNTERPOISE

A. Ground the steel framework of the building with a buried electrode at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2/0 insert size AWG for counterpoise and for tap to building steel. Bury counterpoise not less than 18 inches below grade, or 6 inches below the official frost line, whichever is greater, and 24 inches from building foundation.

3.5 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
3. Verify that final backfill and compaction has been completed before driving rod electrodes.

B. Grounding Conductors: Where the size of the grounding conductors are not shown, size in accordance with NFPA 70 Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

H. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade, pavement, or floor.

I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare, tinned copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at

least four locations and to anchor bolts. Extend grounding conductor above footer and foundation and connect to building structural steel or other grounding electrode external to concrete.

3.6 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible. Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by the manufacturers for indicated applications. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by the manufacturers for types of service indicated.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Replace welds that are puffed up or that show convex surfaces indicating improper cleaning. Use exothermic welded connections for the following:

1. Connecting conductors together.
2. Connecting conductors to ground rods, except at test wells.
3. Connecting conductors to building steel.
4. Connecting conductors to plates.

C. Compression Fittings: Permanent compression-type fittings may be used for the following rather than exothermic connections:

1. Connecting conductors together.
2. Connecting conductors to building steel.
3. Connecting conductors to ground rods, except at test wells.

D. Mechanical Pressure Fittings: Use bolted mechanical (removable) pressure-type clamps for the following:

1. Connecting conductors to ground rods at test wells.
2. Connecting conductors to pipes.

E. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

F. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

G. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

H. Tighten screws and bolts for grounding and bonding 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.

I. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

J. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.7 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

B. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 6 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise encircling the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and

grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade, or 6 inches below the official frost line, whichever is greater, and 6 inches from the foundation.

3.8 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
4. Test Values:

    a. The resistance between the main grounding electrode and earth ground shall be no greater than 5 ohms.

    b. Equipment Rated 500 kVA and Less: 10 ohms.
    c. Equipment Rated 500 to 1000 kVA: 5 ohms.
    d. Equipment Rated More Than 1000 kVA: 3 ohms.
    e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    f. Manhole Grounds: 10 ohms.

5. Perform point–to–point megohmmeter tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
6. Minimum system neutral–to-ground insulation resistance: one megohm.
7. Investigate point-to-point resistance values that exceed 0.5 ohms.

    a. Check for loose connections.
    b. Check for absent or broken connections.
    c. Check for poor quality welds.
    d. Consider other reasons.

8. Excessive Grounding Electrode Resistance: If measured resistance to earth ground value exceeds specified values, notify Architect promptly and include

recommendations and costs to reduce them][add grounding electrodes and additional conductors as required to obtain the specified value.

3.9 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 31 and 32. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for concrete pads for pad-mounted service transformers.

C. Division 23 Section, “Seismic Restraints for Mechanical and Electrical Equipment” for products and installation requirements necessary for compliance with seismic criteria.

D. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

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

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

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

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

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.; a division of Cooper Industries.
    c. ERICO International Corporation.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut; Tyco International, Ltd.
    g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

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

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.; a division of Cooper Industries.
    c. Fabco Plastics Wholesale Limited.
    d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

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

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

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of

conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

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

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

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

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

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

PART 3 - EXECUTION

3.1 APPLICATION

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

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

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

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

3.2 SUPPORT INSTALLATION

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

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

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

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

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

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

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

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

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

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

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

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

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

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

END OF SECTION

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUREMENTS

1.1 SUMMARY

A. This Section includes:

1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for limited scope general construction materials and methods.

C. Division 26 Section “Equipment Wiring Systems” for electrical connections to equipment specified under other Sections, Divisions, or furnished by the Owner.

D. Division 26 Section “Grounding and Bonding”.

E. Division 26 Section “Hangers and Supports for Electrical Systems”.

F. Division 26 Section “Under Floor Raceways for Electrical Systems”.

G. Division 26 Section “Underground Ducts and Raceways for Electrical Systems”.

H. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for supports, anchors, concrete bases, seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.

I. Division 26 Section “Identification for Electrical Systems”.

J. Division 26 Section "Wiring Devices" for devices installed in boxes, power poles, and multi-outlet assemblies.

K. Division 26/27 Section “Common Work Results for Communications”.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.

B. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:

1. Accurately record actual routing of all exterior buried raceway and all interior raceways three inches and larger. Indicate dimensions from fixed structural elements.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in path of conduit groups with supports.
2. HVAC items, plumbing items and architectural features in the paths of conduit groups with common supports.

1.4 DEFINITIONS

A. Terminology used in this specification is as defined below:

1. EMT: Electrical Metallic Tubing
2. ENT: Electrical Nonmetallic Tubing
3. FMC: Flexible Metal Conduit
4. GRS: Galvanized Rigid Steel Conduit
5. IMC: Intermediate Metal Conduit
6. LFMC: Liquidtight Flexible Metal Conduit
7. LFNC: Liquidtight Flexible Nonmetallic Conduit
8. RAC: Rigid Aluminum Conduit
9. RMC: Rigid Metal Conduit
10. RNC: Rigid Nonmetallic Conduit

1.5 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
2. Marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 CONDUITS, SURFACE MOUNTED RACEWAYS AND ACCESSORIES

A. Metal Conduit And Tubing

1. Manufacturers:

a. AFC Cable Systems, Inc.
b. Alflex Corporation, a Southwire Company
c. Anamet Electrical, Inc.; Anaconda Metal Hose.
d. Electri-Flex Co.
e. Indalex
f. Manhattan/CDT/Cole-Flex
g. O-Z/Gedney; Unit of General Signal (Fittings)
h. Republic Raceway
i. Tyco International; Allied Tube & Conduit Div.
j. Western Tube and Conduit Corporation
k. Wheatland Tube Co.

2. RMC:

a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6.

b. RAC: ANSI C80.5, UL6A.

3. IMC: ANSI C80.6, UL 1242.

4. Plastic-Coated GRS and Fittings: NEMA RN 1, UL-listed. Coating thickness of 0.04 inches (1mm), minimum.
5. Plastic-Coated IMC and Fittings: NEMA RN 1, UL-listed.

6. EMT and Fittings: ANSI C80.3, UL 797.

a. Fittings: Compression type.

7. FMC: Aluminum, Zinc-coated steel: UL 1.
8. LFMC: Flexible steel raceway with PVC jacket: UL 360.

a. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

B. Nonmetallic Raceway

1. Available Manufacturers:

a. AFC Cable Systems, Inc. (Tubing)
b. American International.
c. Anamet Electrical, Inc.; Anaconda Metal Hose.
d. Arnco Corp.
e. Cantex Inc.
f. Certainteed Corp.; Pipe & Plastics Group.
g. Condux International.
h. ElecSYS, Inc.
i. Electri-Flex Co.
j. Lamson & Sessions; Carlon Electrical Products.
k. Manhattan/CDT/Cole-Flex.
l. Prime Conduit (formerly Carlon)
m. RACO; Division of Hubbell, Inc.
n. Spiralduct, Inc./AFC Cable Systems, Inc.
o. Superflex Ltd.
p. Thomas & Betts Corporation.

2. RNC: Schedule 40 and 80 PVC: NEMA TC 2, UL 651.

a. Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

3. LFNC: UL 1660.

a. Fittings: match to tubing type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

C. Metal Wireways

1. Available Manufacturer[s]:

a. Cooper B-Line
b. EPI-Electrical Enclosures
c. Hoffman.
d. Square D.

2. Material and Construction: 14 gauge (minimum) sheet steel, sized and shaped as indicated.
3. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system. Select features, unless otherwise

indicated, as required to complete wiring system and to comply with NFPA 70. Where indicated, provide a barrier to divide wireway into compartments.

4. Wireway Covers: Hinged type, or Screw-cover type.
5. Finish: Manufacturer's standard phosphate pre-treatment and baked enamel finish.

D. Nonmetallic Wireways

1. Available Manufacturers:

   a. Enduro Composite Systems
   b. Hoffman.
   c. Lamson & Sessions; Carlon Electrical Products.

2. Description: Fiberglass reinforced polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Gasketed cover with oil-resistant gasket material and fastened with stainless steel captive screws; flanged connections, with stainless-steel screws and oil-resistant gaskets.

3. Description: PVC, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
4. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
5. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Surface Metal Raceways

Available Manufacturers:

   a. Wiremold/Legrand.
   b. Mono-Systems, Inc.
   c. Panduit Corp

2. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

F. Surface Nonmetallic Raceways

1. Available Manufacturers:

   a. Butler Manufacturing Co.; Walker Division.
   b. Enduro Composite Systems.
   c. Hubbell, Inc.; Wiring Device Division.
   d. Lamson & Sessions; Carlon Electrical Products.

e. Panduit Corp.
f. Mono-Systems, Inc.
g. Wiremold/LegrandSelect standard or optional color in paragraph below.

2. Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.3 BOXES, ENCLOSURES AND CABINETS

A. General

1. Available Manufacturers:

a. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
b. Emerson/General Signal; Appleton Electric Company.
c. Erickson Electrical Equipment Co.
d. Hoffman.
e. Hubbell, Inc.
f. Killark Electric Manufacturing Co.
g. O-Z/Gedney; Unit of General Signal.
h. RACO; Division of Hubbell, Inc.
i. Robroy Industries, Inc.; Enclosure Division.
j. Scott Fetzer Co.; Adalet-PLM Division.
k. Spring City Electrical Manufacturing Co.
l. Thomas & Betts Corporation.
m. Walker Systems, Inc.; Wiremold Company (The).
n. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary

B. Outlet Boxes

1. Sheet Metal Outlet and Device Boxes: NEMA OS 1; UL514A.

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

3. Nonmetallic Outlet and Device Boxes: NEMA OS 2

4. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the following paragraphs. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Available Manufacturers listed above and models that meet the specified criteria.

a. Boxes for exposed work: deep drawn type with raised covers:

1) Appleton 4S 1/2-DR; 8300 series cover.
2) RACO 190 series; 800 series cover.
3) Steel City 52150 series; RS series cover.

b. Concealed and exposed boxes for lighting:

1) Appleton 40-3/4.
2) RACO 160 series.
3) Steel City 54170 series.

c. Boxes imbedded in concrete for lighting:

1) Appleton OCR
2) RACO 270 or 280 series.
3) Steel City 54500 series.

d. Boxes for flush switches, receptacles, or other general devices:

1) Appleton 4SVB series; 8400 series cover.
2) RACO 198 series; 770 series cover.
3) Steel City CWV series; 52-C-00 series cover.

e. Boxes for flush switches, receptacles, or other general devices installed in masonry construction:

1) Appleton MI-250 series or MI-350 series.
2) RACO 690 series or 960 series.
3) Steel City GW series.

f. Boxes for telephone, data, telecommunications and audio-video outlets, refer to Division 27 Section “Common Work Results for Communications”.

g. Exposed weatherproof boxes for general devices: cast aluminum with mounting lugs and neoprene gasket:

1) Appleton FDB series.
2) RACO 5300 series.
3) Steel City T100L or LT100L series.

h. Exposed weatherproof boxes for general devices: cast aluminum with neoprene gasket:

1) Appleton FS series.
2) RACO 5300 series.
3) Steel City T100 or LT100 series.

C. Junction and Pull Boxes

1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
2. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast iron with gasketed cover.

D. Cabinets and Enclosures

1. General:

a. Compliance: NEMA 250; UL 50 and 508A, as applicable.
b. NEMA Type 1: Code-gauge phosphatized steel with continuously welded seams; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed removable hinged front cover, with flush [keyed] latch and concealed hinge; collar studs.
c. NEMA Type 3R: Code-gauge galvanized steel with drip shield top, seam-free front, side, and back; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed continuous-hinged door, with stainless steel pin; captive, plated steel cover screws; hasp and staple for padlocking; collar studs.

d. Removable painted steel interior panel mounted on standoffs; metal barriers to separate wiring of different systems and voltages.

e. Where keyed locks are indicated, provide 2 keys for each enclosure, with all locks keyed alike.
f. Provide enclosures wider than 36 inches with double doors; removable center posts; internal bracing, supports, or both, as required to maintain their structural integrity; and, accessory feet where required for freestanding equipment.
g. Provide clamps, grids, slotted wireways, or similar devices to which or by which wiring may be secured. Provide DIN-rail mounted terminal strips for terminating all incoming and outgoing control wiring, and power terminal blocks for incoming/outgoing power wiring.
h. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power and higher-voltage control wiring.

2.4 FACTORY FINISHES

A. Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

B. Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard color paint applied to factory-assembled metal wireway and surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAYS

A. General

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

2. Provide sizes and types of raceways as indicated on the Drawings. Sizes are based on THWN insulated copper conductors, except where noted otherwise. Where sizes are not shown on the Drawings or in the Specifications, size raceways in accordance with NFPA 70 requirements for the number, size and type of conductors installed. Minimum raceway size: 1/2 inch (concealed and exposed); 1 inch (underground and under slab).
3. Provide all raceways, fittings, supports, and miscellaneous hardware required for a complete electrical system as described by the Drawings and Specifications.

4. Install a green-insulated, equipment-grounding conductor, which is bonded to the electrical system ground, in all raceways, with the exception of Service Entrance raceways.
5. Install grounding bushings on all conduit terminations and bond to the enclosure, equipment grounding conductor, and electrical system ground.
6. Install raceways concealed in walls or above suspended ceilings in finished areas. When approved by the Architect, raceways may be installed concealed in elevated floor slabs. Do not install raceways horizontally within slabs on grade.
7. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
8. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
9. Make bends and offsets so inside diameters are not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
10. Install raceways:

    a. To meet the requirements of the structure and the requirements of all other Work on the Project.
    b. To clear all openings, depressions, ducts, pipes, reinforcing steel, and so on.
    c. Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Architect.
    d. Parallel or perpendicular to building lines or column lines.
    e. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

11. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.

    a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

b. Space raceways laterally to prevent voids in concrete.
c. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
d. Change from RNC to coated GRS or IMC before rising above the floor.

12. Where masonry walls are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed and the wall will have a neat and smooth appearance.

13. Support raceways from structural elements of the building as required by NFPA 70, Division 26 Section “Hangers and Supports for Electrical Systems”, Do not support raceways by hangers used for any other systems foreign to the electrical systems; and, do not attach to other foreign systems. Do not lay raceways on top of the ceiling system.
14. Provide support spacing in accordance with NFPA 70 requirements, and at a minimum in accordance with NEMA standards. Support by the following methods:

a. Attach single raceway directly to structural steel with beam clamps.
b. Attach single raceway directly to concrete with one-hole clamps or clips and anchors. Outdoors and wherever subject to dampness or moisture, offset raceways from the surface by using galvanized clamps and clamp backs, to mitigate moisture entrapment between raceways and surfaces.
c. Attach groups of raceway to structural steel with slotted support system attached with beam clamps. Attach raceway to slotted channel with approved raceway clamps.
d. Attach groups of raceway to concrete with cast-in-place steel slotted channel fabricated specifically for concrete embedment. Attach raceway to steel slotted channel with approved raceway clamps.
e. Hang plumb horizontally suspended single raceway using a threaded rod. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to threaded rod with approved raceway clamps.
f. Hang horizontally suspended groups of raceway using steel slotted support system suspended from threaded rods. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to steel slotted channel with approved raceway clamps.
g. Support conductors in vertical raceway in accordance with NFPA 70 requirements.
h. Cross-brace suspended raceway to prevent lateral movement during seismic activity.
i. Use pre-fabricated non-metallic spacers for parallel runs of underground or under-slab conduits, either direct buried or encased in concrete.

15. Install electrically- and physically-continuous raceways between connections to outlets, boxes, panelboards, cabinets, and other electrical equipment with a

minimum possible number of bends and not more than the equivalent of four 90-degree bends between boxes. Make bends smooth and even, without flattening raceway or flaking the finish.

16. Protect all electrical Work against damage during construction. Repair all Work damaged or moved out of line after rough-in, to meet the Architect's approval, without additional cost to the Owner. Cover or temporarily plug openings in boxes or raceways to keep raceways clean during construction. Clean all raceways prior to pulling conductors or cables.
17. Align and install raceway terminations true and plumb.
18. Complete raceway installation before starting conductor installation.
19. Install a pull cord in each empty raceway that is left empty for installation of wires or cables by other trades or under separate contracts. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull cord.
20. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints.
21. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Architect, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Architect, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.

22. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces or from building exterior to building interior.
    b. Where otherwise required by NFPA 70.

23. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with IMC; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

B. RMC

1. Use GRS or IMC in the following areas:

    a. Where indicated.
    b. Exterior applications where above grade and exposed.
    c. Below grade when concrete-encased, plastic-coated, or provided with a corrosion resistant approved mastic coating.
    d. All raceways penetrating slabs on grade (use plastic-coated raceway or provide with a corrosion resistant approved mastic coating). This shall

include the 90-degree elbow below grade and the entire vertical transition to above grade.

e. Exposed, in garages:

1) GRS: vertical risers below 7 feet AFF, when exposed to vehicular traffic

C. EMT

1. Use EMT in the following areas:

a. Where indicated.
b. Interior concealed locations for:

1) Branch and feeder circuits.
2) Low-voltage control, security, and fire alarm circuits

2. Do not use EMT:

a. Below grade.
b. In exterior applications when exposed.

D. FMC and LFMC

1. Use FMC or LFMC:

a. For the final 24 inches of raceway to all motors, transformers, and other equipment subject to vibration or movement.
b. From outlet boxes (attached to building structure) to recessed light fixtures. Install sufficient length to allow for relocating each light fixture within a 5-foot radius of its installed location.

2. Do not use FMC or LFMC:

a. For branch circuits, homeruns or feeders.
b. In lengths exceeding 6 feet.

3. Use FMC only in dry locations; use LFMC in damp, wet, corrosive, and outdoor locations.

E. RNC

1. Solvent-weld RNC fittings and raceway couplings per the manufacturer's instructions and make all connections watertight. Use solvent of the same manufacturer as the raceway.

2. Where installed exposed outdoors or other areas subject to temperature variations, install expansion fittings per Article 352.44 of NFPA 70, to accommodate thermal expansion in straight runs.
3. Use RNC in the following locations:

    a. Only where specifically indicated, and then only as specified below.

    b. Underground, single and grouped, in lieu of GRS or IMC, when indicated.

        1) Direct buried
        2) Concrete-encased (use approved rigid PVC interlocking spacers, selected to provide minimum duct spacing and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts).

4. Do not use RNC:

    a. Exposed indoors
    b. In occupied spaces.
    c. In return air plenums.
    d. Where subject to physical damage.
    e. Where not permitted by codes.

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

1. RMC and IMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings and installation tools approved by the manufacturer for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits. Replace all fittings and conduits that have any portion of the coating scraped off to bare metal, at no additional cost to the Owner.
3. Join raceways with fittings designed and approved for that purpose and make joints tight.
4. Use insulating bushings to protect conductors at raceway terminations:

    a. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
    b. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

G. Telephone and Signal/Data System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

H. Wireways

1. Use flat head screws, clips and straps to fasten wireways to surfaces. Mount plumb and level.
2. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
3. Close ends of wireway and unused raceway openings.

I. Surface Raceways

1. Use flat head screws, clips and straps to fasten surface raceways to surfaces. Mount plumb and level.
2. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
3. Close ends of surface raceway.

3.2 BOXES

A. General

1. Verify locations of device boxes prior to rough in.
2. Set boxes at elevations to accommodate mounting heights as specified or indicated on the Drawings.
3. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box locations to accommodate intended purpose.
4. Install boxes to preserve fire ratings of walls, floors, and ceilings.
5. Install flush wall-mounted boxes without damaging wall insulation or reducing its effectiveness.
6. Support boxes independently of raceway.
7. Clean the interior of boxes to remove dust, debris, and other material. Clean exposed surfaces and restore finish.
8. Adjust flush-mounted boxes to make front edges flush with finished wall material.
9. Provide boxes of the depth required for the service, device and the application, and with raised covers set flush with the finished wall surface for boxes concealed in plaster finishes. Select covers with the proper openings for the devices being installed in the boxes. Install boxes flush unless otherwise indicated.
10. Install outlet boxes in firewalls complying with UL requirements, with box surface area not exceeding 16 square inches; and, when installed on opposite sides of the wall, separate by a distance of at least 24 inches.

B. Outlet Boxes

1. Install all electrical devices, such as plug receptacles, lamp receptacles, light switches, and light fixtures in or on outlet boxes.
2. Locations of outlets on Drawings are approximate; and, except where dimensions are shown, determine exact dimensions for locations of outlets from plans, details, sections, or elevations on Drawings, or as directed by Architect. Locate outlets

generally from column centers and finish wall lines or to centers or joints of wall or ceiling panels.

3. Locate outlet boxes so they are not placed back-to-back in the same wall, and in metal stud walls, so they are separated by at least one stud space, to limit sound transmission from room to room. Install outlet boxes in accessible locations and do not install outlets above ducts or behind furring.
4. Install extension and plaster rings as required by NFPA 70.
5. Carefully set outlet boxes concealed in non-plastered block walls so as to line up with wall joints. Coordinate the box and raceway installation with the wall construction as required for a flush and neat appearing installation. Outlet box extensions may be used where necessary.
6. Do not exceed allowable fill per NFPA 70.
7. Where multiple devices are shown grouped together, gang mount with a common cover plate.

C. Junction and Pull Boxes

1. Install junction and pull boxes above accessible ceilings and in unfinished areas.
2. Provide boxes set flush in painted walls or ceilings with primer coated cover.
3. Where junction and pull boxes are installed above an inaccessible ceiling, locate so as to be easily accessible from a ceiling access panel.
4. Boxes for exterior use shall be:

   a. PVC with a UV-stabilized PVC cover sealed and gasketed watertight.
   b. Cast aluminum with a cast aluminum cover sealed and gasketed watertight.
   c. Cast iron with cast iron cover sealed and gasketed watertight in vehicular traffic areas. Provide box and cover UL listed for use in vehicular traffic areas.
   d. Install buried boxes so that box covers are flush with grade, unless indicated otherwise.

D. Floor Boxes

1. Use cast or non-metallic floor boxes for installations in slab on grade. Unless otherwise indicated, formed steel boxes are acceptable for slabs above grade.
2. Set metal floor boxes level and flush with finished floor surface.

3. Set non-metallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 CABINETS AND ENCLOSURES

A. Unless otherwise indicated on the Drawings, provide NEMA 1 construction for indoor, dry locations; NEMA 12 for indoor, damp and dusty locations; NEMA 3R for outdoor locations.

B. Install flush mounted in the wall in finished spaces, with the top 78 inches above finished floor. The front shall be approximately 3/4-inch larger than the box all around.

C. Install surface mounted in unfinished spaces, with the top 78 inches above finished floor. The front shall be the same height and width as the box.

D. Electrically ground all metallic cabinets and enclosures. Where wiring to cabinet or enclosure includes a grounding conductor, provide a grounding lug in the interior of the cabinet or enclosure. Cabinets and enclosures specified in this Section are intended to house miscellaneous electrical components assembled in a custom arrangement, such as contactors and relays.

E. All components that are specified or indicated for assembly in cabinets and enclosures shall each be individually UL listed and labeled. Arrange wiring so that it can be readily identified. Support wiring no less than every 3 inches. Install gauges, meters, pilot lights and controls on the face of the door.

F. Do not provide cabinets and enclosures smaller than the sizes indicated. Where sizes and types are not indicated, provide cabinets and enclosures of the size, type and classes appropriate for the use and location per the guidelines of the NEC. Provide all items complete with covers and accessories required for the intended use.

END OF SECTION

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes:

1. Raceways, fittings, boxes, handholes, and manholes for direct buried and concrete-encased electrical distribution.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section "Common Work Results for Electrical” for limited scope general construction materials and methods.

C. Division 26 Section “Grounding and bonding”

D. Division 26 Section "Identification for Electrical Systems”

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:

1. Product data for the following products:

a. Raceways, Raceway fittings, separators, duct-bank materials, manholes, handholes, boxes, solvent cement, warning tape and warning planks.

2. Shop drawings for:

a. Detailing fabrication and installation for custom manholes or handholes including duct entry provisions, reinforcing details, frame and cover design, manhole frame support rings, ladder details, grounding details, sump details, joint details, and cable racks, pulling irons, lifting irons.

B. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:

1. Accurately record actual routing of all exterior buried raceway including coordination with other surrounding utilities and underground structures. Provide

scaled plans and sections that Indicate dimensions from finished grade or other fixed structural elements.

1.4 DEFINITIONS

A. Terminology used in this specification is as defined below:

1. GRS: Galvanized Rigid Steel Conduit
2. RMC: Rigid Metal Conduit
3. RNC: Rigid Nonmetallic Conduit

1.5 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
2. Marked for intended use.

C. Comply with NFPA 70 and ANSI C2.

D. Test and inspect pre-cast concrete utility structures according to ASTM C 1037.

E. Non-concrete Handhold and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to project site with ends capped and store nonmetallic ducts with supports to prevent bending, warping, and deformation.

B. Store pre-cast and other factory –fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings, if present, are visible.

C. Lift and support pre-cast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

A. Interruption of existing electrical service to occupied facilities shall not occur unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated.

1. Notify Architect no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architects written permission.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

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

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 RACEWAYS AND FITTINGS

A. Metal Conduit

1. Available Manufacturers:

a. AFC Cable Systems, Inc.
b. Alflex Corporation, a Southwire Company
c. Anamet Electrical, Inc.; Anaconda Metal Hose.
d. Electri-Flex Co.
e. Indalex
f. Manhattan/CDT/Cole-Flex
g. O-Z/Gedney; Unit of General Signal (Fittings)
h. Republic Raceway
i. Tyco International; Allied Tube & Conduit Div.
j. Wheatland Tube Co.

2. RMC:

a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6

3. Plastic-Coated GRS and Fittings: NEMA RN 1, UL-listed. Coating thickness of 0.40 inches (1 mm), minimum.
4. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

B. Nonmetallic Raceway

1. Available Manufacturers:

a. AFC Cable Systems, Inc. (Tubing)
b. American International.
c. Anamet Electrical, Inc.; Anaconda Metal Hose.
d. Arnco Corp.
e. Cantex Inc.
f. Certainteed Corp.; Pipe & Plastics Group.
g. Condux International.
h. ElecSYS, Inc.
i. Electri-Flex Co.
j. Lamson & Sessions; Carlon Electrical Products.
k. Manhattan/CDT/Cole-Flex.
l. RACO; Division of Hubbell, Inc.
m. Spiralduct, Inc./AFC Cable Systems, Inc.
n. Superflex Ltd.
o. Thomas & Betts Corporation.

2. RNC: Schedule 40 (type EPC-40-PVC) and 80 (type EPC-80-PVC PVC: NEMA TC 2, UL 651.

a. a. Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

C. DUCT ACCESSORIES

1. Duct Separators shall be factory-fabricated rigid interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Underground-line warning tape specified in Division 26 Section “Identification for Electrical Systems.”
3. Concrete warning planks shall be nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.

    a. Color: Red dye added to concrete during batching.
    b. Labeling: Mark each plank with “ELECTRICAL” in 2-inch high, 3/8-inch deep letters.

2.3 PRE-CAST CONCRETE HANDHOLES AND BOXES

A. General

1. Available Manufacturers:

    a. Carder Concrete Products.
    b. Christy Concrete Products
    c. Elmhurst-Chicago Stone Co.
    d. Oldcastle Pre-cast Group
    e. Riverton Concrete Products; a division of Cretex Companies, Inc.
    f. Utility Concrete Products, LLC
    g. Utility Vault Co.
    h. Wausau Title, Inc.

B. Comply with ASTM C858 for design and manufacturing process.

C. Pre-cast concrete handholes and boxes shall be factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of the handhole or box.

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

    a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    b. Cover Handle: Recessed.

4. Frame and Cover: Weatherproof aluminum frame, with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.

a. Cover Hinges: Concealed, with hold-open ratchet assembly.
b. Cover Handle: Recessed.

5. The cover finish shall be a nonskid finish with a minimum coefficient of friction of 0.50.
6. The cover shall have the following legend lettering molded into the cover:

a. ["C.A.T.V."]
b. ["COMMUNICATIONS"]
c. ["CONTROLS"]
d. ["ELECTRICAL"]
e. [FIBER OPTICS"]
f. ["LIGHTING"]

7. Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
8. Extensions and slabs shall be designed to mate with bottom of enclosure and shall be same material as enclosure.

a. Extension shall provide increased depth of 12 inches.
b. Slab shall be same dimensions as bottom of enclosure, and arranged to provide closure.

9. Windows shall be included as pre-cast openings in walls arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
b. Window openings shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No.4 steel reinforcing bars in concrete around each opening.

10. Duct entrances into handhole walls shall have cast end-bell or duct–terminating fittings in the wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.
b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

11. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRE-CAST CONCRETE

A. General

1. Description: Comply with SCTE 77.
2. Color of Frame and Cover: Gray where installed in concrete or other paved area; Green where installed in grass area.
3. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated..
4. Load Ratings:

    a. Boxes and covers installed in sidewalks and other areas not subject to normal vehicular traffic shall be rated for a design load of 8,000 lbs. minimum.
    b. Boxes and covers installed in driveways, parking lots, and other off-roadway applications shall be rated for a design load of 15,000 lbs. minimum.
    c. Boxes and covers installed in roadways and other high vehicular traffic areas shall be rated for a design load of 28,800 lbs.

5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, applicable logo from the following:

    a. [“C.A.T.V”]
    b. [“COMMUNICATIONS”]
    c. [“CONTROLS”]
    d. [“ELECTRIC”]
    e. [“FIBER OPTICS”]
    f. [“LIGHTING”]

8. Duct Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pullin-in irons.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

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

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. NewBasis.
    e. Strongwell

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and Backfilling: Comply with Division 31 Section “Earth Moving” but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling and compaction is complete.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections “Turf and Grasses and “Plants”

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section “Cutting and Patching.”

3.2 DUCT INSTALLATION

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

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48-inches, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer’s written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10-inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell with out reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for

duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

F. Sealing: Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and ducts to prevent floating during concreting. Stagger separators approximately 6-inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around the ducts or duct group.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to the manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install ¾-inch reinforcing rod dowels 18-inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured with out soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3-inches between ducts and exterior envelope wall, 2-inches between ducts for like services, and 4-inches between power and signal ducts.
7. Depth: Install top of duct bank at least 24-inches below finished grade in areas not subject to deliberate traffic, and at least 30-inches below finished grade in deliberate traffic paths of vehicles, unless otherwise indicated.

8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
    b. Stub-ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.

9. Warning Tape: Bury warning tape approximately 12 inches above all concrete–encased ducts and duct banks. Align tape parallel to and within 3-inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18-inches. Space additional tapes 12-inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6-inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section “Earth Moving” for pipes less than 6-inches in nominal diameter.
4. Install backfill as specified in Division 31 Section “Earth Moving.”
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4-inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end run and complete backfilling with normal compaction as specified in Division 31 Section “Earth Moving.”
6. Install ducts with a minimum of 3-inches between ducts for like services and 6-inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36-inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.

b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Planks: Bury warning planks approximately 12 inches above all direct-buried ducts an duct banks placing them 24-inches 0.c.. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18-inches. Space additional planks 12-inches apart, horizontally.

3.3 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRE-CAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt pavin gand subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000psi, 28-day strength, complying with Division 03 Section “Cast-in-Place Concrete,” with a troweled finish.
2. Dimensions: 10-inch wide by 12-inches deep.

3.4 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.5 INSTALLATION ACCEPTANCE

A. Prior to final acceptance of the duct bank and associated structures, pull an aluminum of wood test mandrel through the duct to prove joint integrity and to verify ducts have not been deformed. Provide mandrel equal to 80 percent fill of the duct. Test duct bank, manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems." Correct any deficiencies and retest as specified above. Clean internal surfaces of manholes (including sumps) and handholes and remove foreign materials.

END OF SECTION

SECTION 260548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

A. This section includes general seismic requirements specific other sections of the Division 26 specifications.

1.2 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 SUMMARY

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 20 Section “Seismic Controls for MEP/F/T Systems”.

B. The following equipment shall withstand the effects of earthquake motions. The equipment will remain in place without separation of any parts from the device when subjected to the seismic forces specified:

1. Panelboards used in normal power systems
2. Raceways and Boxes used in normal power systems
3. Low-Voltage Transformers used in normal power systems
4. Switchboards used in normal power systems
5. Panelboards used in normal power systems

C. In addition to the requirements above, the following equipment shall be fully operational after the seismic event:

1. Panelboards used in emergency power systems
2. Raceways and Boxes used in emergency power systems
3. Low-Voltage Transformers used in emergency power systems
4. Switchboards used in emergency power systems
5. Panelboards used in emergency power systems

1.4 SUBMITTALS

A. Provide submittals as required by Division 20 Section “Seismic Controls for MEP/F/T Systems” for all electrical systems specified herein.

PART 2 - PRODUCTS AND MATERIALS

(Not Used)

PART 3 - EXECUTION

(Not used)

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes the following:

1. Nameplates
2. Labels for raceways and metal-clad cable.
3. Labels for junction boxes and pull boxes.
4. Labels for wiring devices and lighting control devices.
5. Markers for conductors, and control cables.
6. Tags.
7. Underground-line warning tape.
8. Warning labels and signs.
9. Arc Flash Warning Labels.
10. Instruction signs.
11. Miscellaneous identification products.
12. Painted Identification.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Where a facility identification standard already exists, that standard shall be continued. Where an identification standard does not exist, color-coding and identification shall be as described herein.

B. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

C. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

D. Coordinate installation of identifying devices with location of access panels and doors.

E. Install identifying devices before installing acoustical ceilings and similar concealment.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7 and that are acceptable to authorities having jurisdiction.
2. Marked for intended use.

B. Comply with ANSI A13.1 and ANSI C2.

C. Comply with NFPA 70.

D. Comply with 29 CFR 1910.145.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

A. Location, text, and method of identification to be used is noted in individual sections. Refer to related sections for additional identification requirements.

2.2 NAMEPLATES

A. Engraved, Laminated Acrylic or Melamine Label, adhesive backed. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.

1. Normal systems - white letters on a black background.
2. Emergency systems - white letters on a red background

2.3 LABELS FOR RACEWAYS AND METAL-CLAD CABLE

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

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.4 LABELS FOR JUNCTION BOXES AND PULL BOXES

A. Junction box and pull box covers shall be spray painted to identify the voltage and system. Circuit numbers and the panel they originate from shall be listed on the cover using permanent, waterproof, black ink marker.

2.5 LABELS FOR WIRING DEVICES AND LIGHTING CONTROL DEVICES

A. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.

B. Engraved cover plates: Provide with white letters. White or ivory cover plates shall have black letters.

2.6 MARKERS FOR CONDUCTOR AND CONTROL CABLES

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.

D. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.

2.7 TAGS

A. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.8 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.9 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145. Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied and shall not compromise any NRTL listing or labeling criteria.

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

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

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

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

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning (208 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
3. Workspace Clearance Warning (480 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (915 MM)."

2.10 ARC FLASH WARNING LABELS

A. 3.5 in. x 5 in., unless otherwise noted by Owner, thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be printed after the results of the analysis have been presented and after any system changes, upgrades, or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation
2. Nominal voltage
3. Available fault current
4. Flash protection boundary
5. Hazard risk category
6. Incident energy
7. Working distance
8. Engineering report number, revision number and issue date.

D. Labels shall be machine printed, with no field markings.

2.11 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes. Unless indicated otherwise, provide with minimum 3/8-inch- (10-mm-) high letters.

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

2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.6 kg), minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Fasteners for Nameplates, Labels and Signs

1. Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers unless otherwise noted.

2.13 PAINTED IDENTIFICATION

A. Paint materials and application requirements are specified in Division 09 painting Sections.

1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior concrete and masonry primer.
2) Finish Coats: Exterior semi-gloss acrylic enamel.

2. Exterior Concrete Unit Masonry:

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.

1) Block Filler: Concrete unit masonry block filler.
2) Finish Coats: Exterior semi-gloss acrylic enamel.

3. Exterior Ferrous Metal:

a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior ferrous-metal primer.
2) Finish Coats: Exterior semi-gloss alkyd enamel.

4. Exterior Zinc-Coated Metal (except Raceways):

a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior zinc-coated metal primer.
2) Finish Coats: Exterior semi-gloss alkyd enamel.

5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):

a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior concrete and masonry primer.
2) Finish Coats: Interior semi-gloss alkyd enamel.

6. Interior Concrete Unit Masonry:

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.

1) Block Filler: Concrete unit masonry block filler.
2) Finish Coats: Interior semi-gloss acrylic enamel.

7. Interior Gypsum Board:

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior gypsum board primer.
2) Finish Coats: Interior semi-gloss acrylic enamel.

8. Interior Ferrous Metal:

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior ferrous-metal primer.
2) Finish Coats: Interior semi-gloss acrylic enamel.

9. Interior Zinc-Coated Metal (except Raceways):

a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior zinc-coated metal primer.
2) Finish Coats: Interior semi-gloss acrylic enamel.

PART 3 - EXECUTION

3.1 PREPARATION

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

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

C. Painted Identification: Prepare surface and apply paint according to Division 09 painting sections.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. For surfaces that require finish work, apply identification devices after completing finish work.

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

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

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

F. Equipment Nameplates and Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual

G. For refrigeration systems: Neatly bundle circuits and clearly tag and label each circuit with panelboard, branch circuit designation and refrigeration system number at each termination.

END OF SECTION

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies, and the setting of these devices.

1. Also include coordination of series-rated devices where series rating is specified in other sections and where indicated on Drawings.
2. The AIC ratings indicated on the Drawings are preliminary and will be finalized based on the results of the fault current study. Device ratings for furnished equipment shall be as required by the results of the fault current study at no additional cost.

B. Study must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If study has not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this section.

1.3 SUBMITTALS

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

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals:

1. Coordination-study input data, including completed computer program input data sheets.
2. Coordination-study report.
3. Equipment evaluation report.
4. Arc-Flash Hazard Analysis.
5. Setting report.

E. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:

1. Accurately record on the One-Line Diagram actual ratings and settings for all overcurrent devices, both adjustable and non-adjustable, including all changes made during construction, due to the study, or both.

1.4 QUALITY ASSURANCE

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

B. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 399 for general study procedures.

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

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

PART 2 - PRODUCTS AND MATERIALS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:

1. CYME International, Inc.
2. EDSA Micro Corporation.
3. Electrical Systems Analysis, Inc.
4. SKM Systems Analysis, Inc.
5. Operation Technology, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.

1. Zero-Sequence current.
2. Arcing faults.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.

C. Fault current study and coordination study to be performed prior to the final submittals for any piece of electrical equipment which has an AIC rating or an over-current protective device so that correct equipment gets ordered for the project conditions.

D. Arc Flash Study must be performed after conductors and equipment have been installed and after the project's utility company confirms the available fault current. A final coordination study with all device settings shall be submitted with the Arc Flash Study. The goal of the revised settings is to minimize the arc flash hazard while maintaining reasonable coordination and selectivity. For the components of emergency and legally required standby system components, full selectivity must be maintained.

3.2 SYSTEM COMPONENTS TO BE INCLUDED IN STUDIES

A. Study shall begin with the utility and each alternate power source overcurrent device(s) serving the Project and end at the last branch circuit overcurrent protective device. This includes studies of the complete paths on both sides of any transfer switch, contactor or circuit breaker.

B. Components include, but are not limited to:

1. Switchgear

2. Switchboards
3. Distribution Panelboards
4. Panelboards
5. Motor Control Centers
6. Chiller Controllers
7. Air Handling Equipment
8. Roof Top HVAC equipment
9. Elevator controllers

3.3 POWER SYSTEM DATA FOR STUDIES

A. Gather and tabulate the following input data to support studies:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical distribution system diagram showing the following:

    a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
    b. Circuit-breaker and fuse-current ratings and types.
    c. Relays and associated power and current transformer ratings and ratios.
    d. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    e. Generator kilovolt amperes, size, voltage, and source impedance.
    f. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
    g. Busway ampacity and impedance.
    h. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Magnetic inrush current overload capabilities of transformers.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Ratings, types, and settings of utility company's overcurrent protective devices.
    e. Special overcurrent protective device settings or types stipulated by utility company.
    f. Time-current-characteristic curves of devices indicated to be coordinated.

g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
i. Panelboards, switchboards, motor-control center ampacity, and interrupting ratings in amperes rms symmetrical.

3.4 FAULT-CURRENT STUDY

A. Source Impedance: Utility company's fault-current contribution as indicated.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

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

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

E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:

1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
2. Low-Voltage Fuses: IEEE C37.46.
3. Circuit Breakers: IEEE C37.13.

F. Study Report:

1. Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
3. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.

G. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.

3.5 COORDINATION STUDY

A. Perform coordination study and prepare a written report using the results of fault-current study and approved computer software program. Comply with IEEE 399.

B. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.

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

D. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.

E. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

F. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

G. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
   d. Fuse-current rating and type.
   e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve the level of selective coordination required in the contract documents or by the edition of the National Electrical Code (including any local jurisdiction amendments) the project must comply with. Graphically illustrate that adequate time separation exists between series devices, including power utility company's upstream devices. Show the following specific information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

3. Completed data sheets for setting of overcurrent protective devices.
4. For emergency, legally required standby and health care essential power systems, such systems must selectively coordinate to the values indicated below unless local amendments to the National Electrical Code require a different value.

a. Emergency (NEC article 700) 0.01 seconds
b. Legally Required Standby (NEC article 701) 0.01 seconds
c. Elevator Systems (NEC article 620) 0.01 seconds
d. Health Care Essential Electrical Systems (NEC article 517)

1) Equipment Branch 0.10 seconds
2) Critical Branch 0.01 seconds
3) Life-Safety Branch 0.01 seconds

3.6 OVERCURRENT PROTECTIVE DEVICE SETTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of overcurrent protective devices within equipment.

1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:

a. Verify that overcurrent protective devices meet parameters used in studies.
b. Adjust devices to values listed in study results.
c. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 100.7 and 100.8 in NETA ATS.

3.7 ARC-FLASH HAZARD ANALYSIS

A. Determine arc-flash incident energy levels and flash protection boundary distances based on the results of the Short-Circuit and Coordination studies. Perform the analysis under worst-case arc-flash conditions for all modes of operation.

B. Identify all locations and equipment to be included in the arc-flash hazard analysis:

1. Include a copy of the facility one-line in the report.
2. Identify the possible system operating modes including tie-breaker positions, and parallel generation.

3. Calculate the arcing fault current flowing through each branch for each fault location.
4. Determine the time required to clear the arcing fault current using the protective device settings and associated trip curves.
5. Select the working distances based on system voltage and equipment class.
6. Calculate the incident energy at each fault location at the prescribed working distance.
7. Determine the hazard/risk category (HRC) for the estimated incident energy.
8. Calculate the flash protection boundary at each fault location.
9. Document the assessment in reports and one-line diagrams.
10. Provide labels to be placed on each piece of equipment analyzed. Label shall show the calculated incident energy and hazard/risk category for the calculated incident energy.

C. Results of the arc-flash study shall be summarized in a final report containing the following:

1. Basis, method of hazard assessment, description, purpose, scope, and date of the study.
2. Tabulations of the data used to model the system components and a corresponding one-line diagram.
3. Descriptions of the scenarios evaluated and identification of the scenario used to evaluate equipment ratings.
4. Tabulations of equipment incident energies, hazard risk categories, and flash protection boundaries. The tabulation shall identify and clearly note equipment that exceeds allowable incident energy ratings.
5. Required arc-flash labeling and placement of labels.
6. Conclusions and recommendations.

END OF SECTION

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes the following lighting control devices:

1. Line-voltage wall switch occupancy sensors.
2. Line-voltage occupancy sensors.
3. Line-voltage photoelectric switches.
4. Stand-Alone Low-voltage occupancy sensors.
5. Stand-Alone Low-voltage photoelectric switches.
6. Stand-Alone Low-voltage power packs.
7. Stand-Alone Low-voltage switches.
8. Outdoor motion sensors.
9. Time switches.
10. Lighting contactors.
11. Automatic load control relays.
12. Branch circuit transfer switches.
13. Conductors and Cables for Lighting Control Devices.

1.2 DEFINITIONS

A. Acoustic Type: Occupancy sensor detection type that detects occupancy by listening for acoustic noises.

B. Closed loop: Photosensor control algorithm designed for influence by both daylight and electric light in a space or area.

C. DPDT: Double pole, double throw.

D. DPST: Double pole, single throw.

E. Dual-Technology Type: Occupancy sensor detection type that detects occupancy by using a combination of PIR and ultrasonic or acoustic detection technologies.

F. LED: Light-emitting diode.

G. Open loop: Photosensor control algorithm designed for influence by daylight entering in a space or area.

H. PIR Type: Passive infrared. Occupancy sensor detection type that detects occupancy by sensing a combination of infrared heat and movement.

I. SPST: Single pole, single throw.

J. Ultrasonic Type: Occupancy sensor detection type that detects occupancy by sensing a change in pattern of reflected ultrasonic energy.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.4 SUBMITTALS

A. Product data for the following products:

1. Catalog cut sheets, including major and minor motion coverage patterns sensors, time delay and sensitivity adjustability settings, load restrictions, and performance specification items indicating compliance with this specification for all lighting control devices.

B. Shop Drawings:

1. Occupancy sensors and photoelectric switches

a. Show installation details.
b. Lighting plan showing location, mounting height, orientation and coverage area of each sensor and coordination with other trades.
c. Interconnection diagrams showing field-installed wiring.
d. Include diagrams for power, signal, and control wiring.
e. For any manufacturer submitted other than that listed as the Basis of Design, provide the following information for Engineer review:

1) Factory-generated occupancy sensor and photoelectric switch layouts on project lighting plans with sensor location, orientation and product type clearly marked on plans. Sensor placement shall be coordinated with project reflected ceiling plan layout, ceiling heights, lights, diffusers, and any other ceiling devices and equipment.
2) List of any deviations to this specification or Basis of Design products.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. Occupancy sensors and photoelectric switches:

a. Manufacturer's installation instructions, including instructions for storage, handling, protection, examination, preparation, start-up calibration and installation.

b. Product data clearly showing sensor field adjustments, including dip switch setting definitions and location of settings within sensors.
c. Manufacturer's maintenance, including operating and adjustment instructions.

2. Timeclocks

a. Description of programmed timeclock settings at time of substantial completion.

3. Line-voltage wall box dimming switches

a. Provide operating instructions for each type of dimmer.

1.5 QUALITY ASSURANCE

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

B. Occupancy sensors and photoelectric switches

1. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of 5 years.
2. Products shall be manufactured by an ISO 9001 certified manufacturing facility.
3. Manufacturer shall test all equipment prior to shipment.

1.6 WARRANTY

A. Manufacturers shall provide a five (5) year warranty for sensors and accessories from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

A. PIR type requirements:

1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Sensor shall utilize pulse count processing and digital signature analysis to respond only to those signals caused by human motion.
3. Sensor shall provide high immunity to false triggering from RFI and EMI.
4. Sensor shall have a multiple-segmented fresnel lens in a multiple-tier configuration, with grooves to eliminate dust and residue buildup. Sensor shall be

capable of accepting mask inserts to mask specific portions of the lens to prevent false triggering.

B. Ultrasonic type requirements:

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Frequency (Small Area – 500 sq ft and less): Ultrasonic operating frequency shall be crystal controlled at 40 kHZ within +/- 0.005% tolerance to assure reliable performance and eliminate sensor cross-talk.
3. Detection Frequency (Medium and Large Areas – greater than 500 sq ft): Ultrasonic operating frequency shall be crystal controlled at 32 kHz within +/- 0.005% tolerance, to assure reliable performance and eliminate sensor cross-talk.
4. Sensors shall be capable of automatically adapting to airflow conditions or filtering frequency spectrum related to air movement.

C. Acoustic type requirements:

1. Detector Sensitivity: Acoustic type technology shall only be used as secondary to PIR in a Dual-Technology Type sensor. Specific sensitivity is based on PIR technology.
2. Sensors shall distinguish noises made by human activity (typing, talking, eating, etc.) and filter out noises made by the environment or building (HVAC, equipment, cars, etc.).
3. Acoustic technology shall enhance reliability and accuracy of PIR sensor.

D. Dual-Technology type requirements:

1. Dual-Technology sensors using ultrasonic technology shall have field-selectable controls on unit to determine if a particular technology or combination of technologies controls the on-off function.
2. Dual-Technology sensors using acoustic technology shall have the PIR technology initially detect motion and a combination of PIR and acoustic technologies shall keep the load on.
3. Sensitivity Adjustment: Separate for each sensing technology.
4. Different LED indicator colors for each sensing technology
5. PIR sensor component shall comply with all requirements listed under PIR type requirements.
6. Ultrasonic sensor component shall comply with all requirements listed under Ultrasonic Type requirements.
7. Acoustic sensor component shall comply with all requirements listed under Acoustic Type requirements.

2.2 LINE VOLTAGE WALL SWITCH OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers

specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for Sensors:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C), unless indicated elsewhere for specific model and application.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.

    a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
    b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of the switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.

5. Operation adjustment: Concealed, field-adjustable for auto-on or manual-on operation.
6. Time Delay adjustment:

    a. Concealed, field-adjustable.
    b. Time delay for de-energizing loads shall be adjustable with multiple increments from 30 seconds up to 30 minutes.

7. Adaptive technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false “off” switching.
8. Mounting: Single-gang wall box switch
9. Finish: Sensor finish shall be white.
10. Sensor:

    a. Vandal-resistant lens
    b. Integral sliding blinders or pre-cut tape strips to block sensor views
    c. Protrudes no greater than 0.50 inches from wall.
    d. 180-degree field of view
    e. Major and minor motion coverage patterns confirmed per Nema WD7 guidelines.
    f. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.

11. Indicators:

    a. LED indicator for visual detection of motion

b. audible and/or visual alerts for pending shut-off

12. Suitable for switching load types used, including LED, fluorescent, incandescent, magnetic and electronic low voltage and motor load types. UL listed and labeled, zero-cross relay, no minimum load requirement, ground wire.
13. Wall switch shall have no leakage of current to load and integral service switch to permit a maintained off for servicing of lamps for safety purposes
14. Buttons/Relays: Provide control relay and push button quantities as indicated by model listed in Lighting Control Device Schedule.
15. Restriction on leakage to grounding conductor.

    a. For new construction: Dual-technology wall switch sensor shall have not more than 0.5ma leakage of current to ground per UL requirements. Provide and connect a neutral conductor to these devices.

2.3 LINE-VOLTAGE OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors. Integral relay unit for line voltage sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. UL Listed for dry locations and complies with local codes.
3. Operation: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Upon occupancy of space, loads shall turn on. If occupancy is not detected with in the time delay period, loads shall de-energize. Time delay for de-energizing loads shall be adjustable over a minimum range of 1 to 15 minutes with a maximum of 30 minutes.
4. Switch Rating: As indicated in Lighting Control Device Schedule.
5. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
6. Mounting: Suitable for mounting in any position on a standard outlet box.
7. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
8. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
9. Bypass Switch: Override the “on” function in case of sensor failure, concealed on unit to prevent tampering.
10. Finish: Sensor finish shall be white.
11. Operating temperatures: Unless indicated otherwise for specific models, 32 degree F through 104 degree F, and relative humidity of 0%-95%.

12. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
13. Device shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
14. Device and related relays shall be compatible with the specific load types controlled.
15. Sensor:

    a. Coverage pattern: As indicated in Lighting Control Device Schedule, and shall have been confirmed with NEMA WD7 Guide and Robotic test method.
    b. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.

C. High-Bay Model:

1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
2. Detection Coverage: Selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.

D. Extreme Temperature Model:

1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

2.4 LINE-VOLTAGE PHOTOELECTRIC SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. Outdoor:

1. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

    a. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photoelectric switch to prevent fixed light sources from causing turn-off.
    b. Time Delay: 15-second minimum, to prevent false operation.

c. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
d. Mounting: Base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.5 STAND-ALONE LOW-VOLTAGE OCCUPANCY/VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensor unit, for use with a separate stand-alone low-voltage power pack containing a line-voltage relay.

1. Occupancy sensors and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. UL Listed for dry locations and complies with local codes.
4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.

    a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
    b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of a separate, associated switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.

5. Switch Rating: As indicated in Lighting Control Device Schedule.
6. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
7. Mounting: Suitable for mounting in any position on a standard outlet box.
8. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
9. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
10. Bypass Switch: Override the “on” function in case of sensor failure, concealed on unit to prevent tampering.
11. Finish: Sensor finish shall be white.
12. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

13. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
14. Sensors:

    a. Sensor shall be compatible with lighting control system.
    b. Sensors shall be capable of being combined with additional sensors to achieve adequate coverage.
    c. Sensor coverage pattern: AS indicated on Lighting Control Device Schedule, and shall have been confirmed with Nema WD7 Guide and Robotic test method.
    d. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.

C. High-Bay Model:

1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.

D. Extreme Temperature Model:

1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

2.6 STAND-ALONE LOW-VOLTAGE PHOTOELECTRIC SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for switches: Ceiling-mounted, solid-state indoor photoelectric switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.

1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. UL Listed for dry locations and complies with local codes.
4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Upon ambient

light level measurement reading below setpoint, loads shall be de-energized. Upon ambient light level measurement reading above setpoint, loads shall be energized.

5. Finish: Sensor finish shall be white.

C. Outdoor:

1. Description: Solid state, low voltage with contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered [from the power pack][from the lighting control system][as indicated on the Drawings].

   a. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
   b. Time Delay: 30-second minimum, to prevent false operation.
   c. Lightning Arrester: Air-gap type.
   d. Mounting: Twist lock complying with IEEE C136.10, with base.

2.7 STAND-ALONE LOW-VOLTAGE POWER PACKS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for power packs: Box mounted, solid-state indoor power pack/relay unit, for use with a separate stand-alone low-voltage sensor and switches.

1. Power packs and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. UL Listed for dry locations and complies with local codes.
4. Unit shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
5. Relay shall be compatible with the specific lighting types controlled.
6. Operations: Refer to drawings for Sequence of Operations or other operational instructions. Unit operates in conjunction with other system components. Refer to operations requirements of associated devices.
7. Switch Rating: As indicated in Lighting Control Device Schedule.
   Mounting: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
8. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.8 STAND-ALONE LOW-VOLTAGE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for switches: Wall-mounted, solid-state indoor manual switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.

1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. UL Listed for dry locations and complies with local codes.
4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Manual push of any button shall energize or de-energize loads.
5. Mounting: Suitable for mounting in any position on a standard outlet box.
6. Indicator: LED, for each button to indicate when loads are energized and de-energized.
7. Finish: Sensor finish shall be white.
8. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.9 OUTDOOR MOTION SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Weatherproof, detection technology as indicated in the Lighting Control Device Schedule on the Drawings.
3. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
4. Detection Coverage: As indicated in Lighting Control Device Schedule on the Drawings.

5. Switch Rating: Line Voltage: Minimum 1000-W incandescent and 500-VA ballast load at 120-V ac; 1000W ballast load at 277-V ac. Voltage as indicated on Drawings and Lighting Control Device Schedule.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 1 to 20 FC. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector with multiple increments from 30 seconds up to 15 minutes.
8. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 14 to plus 130 deg F, rated as "rain tight" according to UL 773A.
9. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outdoor junction box and ½" threaded nipple for use with standard NEMA weatherproof fixture fitting.
    b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

10. Bypass Switch: Override the on function in case of sensor failure.

2.10 TIME SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Intermatic, Inc.
3. Leviton Mfg. Company Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Paragon Electric Co.; Invensys Climate Controls.
6. Square D; Schneider Electric.
7. TORK; NSI Industries.
8. Wattstopper; a Legrand Company.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac.
3. Program: 2 channels; each channel shall be individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
4. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

5. Circuitry: Allow connection of a photoelectric switch relay as substitute for on-off function of a program.
6. Astronomic Time: All channels.
7. Battery Backup: For schedules and time clock.

C. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: [SPST] [DPST] [DPDT.
2. Contact Rating: 20-A ballast load, 120/240-V ac.
3. Astronomic Time: [All] [Selected] channels.
4. Battery Backup: For schedules and time clock.

2.11 LIGHTING CONTACTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. ASCO Power Technologies, LP; a division of Emerson Electric Co.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. GE Industrial Systems; Total Lighting Control.
4. Hubbell Lighting.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. Square D; Schneider Electric.
7. TORK; NSI Industries.

B. Description: Electrically operated and mechanically held, combination type with non-fused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including LED tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation. Refer to FCA value on drawings, at nearest upstream device.
3. Enclosure: Provide with enclosure complying with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.12 AUTOMATIC LOAD CONTROL RELAYS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. For control of emergency lighting circuits: Loss of normal power shall cause relay to automatically shunt emergency power to lighting circuit regardless of manual or automatic switch position. Emergency lighting circuit shall continue to operate at full power until normal power has been restored.
2. Coil Rating: 120 or 277 V, as indicated on Drawings.
3. Mounting: Either a 2-gang outlet box with separation barrier and plaster ring or a wall-mountable box with separate compartments. Mount per manufacturer's instructions.
4. Auxiliary Relay input: Provisions to shunt emergency lighting on upon receiving a signal from an outside system such as security or fire alarm system.

2.13 BRANCH CIRCUIT TRANSFER SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 1008.

1. For control of emergency lighting circuits: Loss of normal power shall cause relay to automatically shunt emergency power to lighting circuit regardless of manual or automatic switch position. Emergency lighting circuit shall continue to operate at full power until normal power has been restored.
2. Coil Rating: 120 or 277 V as indicated on Drawings.

2.14 CONDUCTORS AND CABLES FOR LIGHTING CONROL DEVICES

A. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.

B. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.

C. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG.

D. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG.

E. Provide all necessary conductor and cabling required for operation of the controls and control systems specified. This includes power and control wiring required for the controls to operate as described.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL

1. Install devices and associated power packs and wiring in accordance with manufacturer's instructions and applicable codes.

B. LINE VOLTAGE WALL SWITCHES

1. Install dimming wall switches to achieve full rating specified on Lighting Control Device Schedule taking into account de-rating for ganging as instructed by the manufacturer.
2. Provide a separate grounded (neutral) conductor for each circuit controlled by a line voltage switch.

    a. Do not share neutral conductor on load side of dimmers.
    b. If neutral termination is not required for the device, cap conductor and tag as "Neutral for future use".

C. OCCUPANCY/VACANCY SENSORS AND PHOTOELECTRIC SWITCHES

1. Arrange a pre-installation meeting with manufacturer's factory authorized field representative, at Owner's facility, to verify placement of sensors and installation criteria.
2. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage areas specified in manufacturer's literature. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms or areas that are to be provided with sensors. Provide additional sensors as required to properly and completely cover the respective areas.
3. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems and partition assemblies.
4. Occupancy sensors with ultrasonic or dual-technology sensing technologies shall be located not closer than 4 feet from the nearest edge of air supply devices or similar obstructions that would adversely affect the sensor performance.
5. Adjust time delay setting of occupancy sensors to de-energize loads after space has been unoccupied for period of time indicated on the Drawings.
6. Install outdoor photoelectric switches with clear view of the northern sky unless noted otherwise on the Drawings.
7. Adjust settings of photoelectric switches to turn on lighting at illumination level indicated on the Drawings.
8. Install devices and auxiliary equipment in compliance with manufacturer's instructions and recommendations.

9. Install relay units where concealed from view and where accessible.
10. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
11. Install switchbox mounted occupancy sensors at same elevation as other lighting control switches.

D. TIME SWITCHES

1. Install time switches in locations as indicated on the Drawings.
2. Program time switches with current time and date information in accordance with manufacturer's instructions.
3. Program timeclock settings as per Sequence of Operations on the Drawings. Confirm final timeclock settings with Owner prior to programming.

E. LIGHTING CONTACTORS

1. Install lighting contactors in locations as indicated on the Drawings.
2. Provide NEMA 1 enclosures for lighting contactors in interior dry locations, NEMA 3R enclosures for lighting contactors in exterior or wet locations.
3. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

F. AUTOMATIC LOAD CONTROL RELAYS

1. When used with manual controls, install emergency shunt relay in separate enclosure adjacent to associated light switch or in accessible ceiling near the control device or wall mounted within electrical room. Label within enclosure the connected normal and emergency circuits.
2. When used with automatic controls, install where concealed from view in accessible ceiling near the automatic control device or wall mounted within electrical room. Label outlet box cover with connected normal and emergency circuits.

G. BRANCH CIRCUIT TRANSFER SWITCHES

1. Install branch circuit transfer switches where concealed from view in accessible ceiling near the automatic control device or wall mounted within electrical room. Label outlet box cover with connected normal and emergency circuits.

H. WIRING

1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be [1/2 inch (13 mm)][<insert size>].
2. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

3. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."

B. Power and control wiring: Identify using marker tapes.

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric switches and occupancy sensors at each sensor.

C. Components: Label each component with self-laminating computer printed labels, using a unique designation matching control drawing.

D. Cover plates: Refer to drawings for labeling requirements of certain cover plates for manual switches, or similar devices, requiring labeling for user information.

E. Buttons/switches:

1. Engraved from manufacturer. Refer to drawings for detailed requirements and text for labeling.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Test all occupancy sensors in test mode to confirm sensor coverage and sensitivity of sensor per manufacturer’s instructions. Upon completion of tests, set sensor time delay as indicated on Lighting Control Device Schedule. Follow testing and adjustment procedures as written in the manufacturer’s installation instructions for each sensor model.

B. Lighting control devices that fail tests and inspections are defective work. Remove, replace, and retest devices that fail tests.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

B. Photoelectric switch Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project for this purpose.

3.5 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Lighting Control Systems."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training" and Division 26 Section "Lighting Control Systems" for additional information

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Distribution panelboards.

B. Lighting and appliance branch-circuit panelboards.

C. Load centers.

D. Disconnecting and Overcurrent Protective Devices.

E. Fused Lighting and Appliance Branch-Circuit Panelboards.

F. Surge Protection Devices.

G. Accessory Components and Features.

1.2 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protection Device

1.3 ADMINISTRATIVE REQUIREMENTS

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

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit electronic files, in an SKM-compatible format.

C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section “Overcurrent Protective Device Coordination Study”

D. Qualification Data: For qualified testing agency.

E. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: Submit final panelboard directories.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

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

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

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

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to occupied facilities. Refer to Division 26 Section “General Electrical Requirements” for allowable outages.

1.8 WARRANTY

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

1.9 SEISMIC REQUIREMENTS

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 Section “Seismic Controls for Electrical Systems” and Division 20 Section “Seismic Controls for MEP/F/T Systems”.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

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

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

B. Enclosures: Flush- or surface-mounted cabinets as noted.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.

2. Hinged Front Cover: Entire front trim hinged to box.
3. Door: Standard door with concealed hinges, within hinged trim cover. Secured with vault-type latch with tumbler lock; keyed alike.
4. Skirt for Surface-Mounted Panelboards: Same gauge and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gauge and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.
c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and/or bottom as required.

D. Buses: Three phase, four wire unless otherwise indicated.

1. Phase, and Neutral Buses:

a. Material:

1) Tin-plated aluminum.

a) Hard-drawn copper, 98 percent conductivity,may be substituted if provided at no additional cost.

2) Hard-drawn copper, 98 percent conductivity.

b. Size: Ampacity as indicated on drawings, with uniform capacity for entire length of panelboard's sections.

1) Neutral bus: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus

2. Ground Bus: Equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

a. Material: Hard-drawn copper, 98 percent conductivity
b. Size: Minimum-size required by UL 67

3. Split Bus: Vertical buses divided horizontally into individual vertical sections.

E. Line-Side Conductor Connectors (Lugs):

1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
2. Material: Same as bus material.
3. Capacity rating: Same as associated bus.
4. Type: Provide mechanical type unless otherwise indicated on Drawings, refer to schedules and one-line diagram.

F. Feed-Through Lugs:

1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
2. Location: Locate at opposite end of bus from line side lugs or main device.
3. Material: Same as line side conductor connectors.
4. Capacity rating: Same as associated bus.
5. Type: Same as line side conductor connectors.

G. Subfeed lugs (Double Lugs):

1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section “Low-Voltage Electrical Power Conductors and Cables”.
2. Location: Locate at same end of bus as incoming lugs or main device.
3. Material: Same as line side conductor connectors.
4. Capacity rating: Same as associated bus.
5. Type: Same as line side conductor connectors.

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

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

J. Panelboard Short-Circuit Current Rating – Fully Rated: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. See manufacturers above.

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

C. Doors: For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: As indicated on drawings.

E. Branch Overcurrent Protective Devices:

1. Connection to bus:

a. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
b. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2. Type: Provide types as indicated on drawings and as defined below.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. See manufacturers above.

B. Panelboards: Circuit breaker type: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As indicated on drawings.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

2.4 LOAD CENTERS

A. See manufacturers above.

B. Load Centers: Comply with UL 67.

C. Mains: As indicated on drawings.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. See manufacturers above.

B. Arc Flash Mitigation

1. Overcurrent devices, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.

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

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical type unless otherwise indicated on Drawings, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

        1) Mounting: Integral

    e. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second] time delay.
    f. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
    h. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
    i. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on position.
    k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

E. Fuses are specified in Division 26 Section "Fuses."

2.6 SURGE PROTECTION DEVICES

A. Provide surge protective devices as required by Division 26 Section “Surge Protective Devices”.

B. Panelboards requiring SPD and the location of the devices shall be as indicated on the Drawings.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Wall-Mounted Panelboards: Install panelboards on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For panelboards not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

C. Floor-Mounted Panelboards: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. Support panelboards on concrete base.
3. Attach panelboards to the vertical finished or structural surface behind the panelboards.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

E. Mount top of trim 72 inches (1788 mm)above finished floor unless otherwise indicated.

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

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

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

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

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with a nameplate.

C. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate.

D. Warning Labels: Label each panelboard with a warning label in accordance with NFPA 70 and NFPA 70E.

1. Exception: Do not install NFPA 70 working clearance requirements on flush panelboards and similar equipment in finished spaces.

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

F. Panel Directories

1. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
2. Noted the date the directory was created/updated.
3. Create directory after loads have been balanced.
4. Replace existing directories with revised type written directories indicating changes.

3.4 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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

B. Acceptance Testing Preparation:

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

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

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

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

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Receptacles: Single, duplex, USB/duplex, USB-only, twist-lock, ground-fault circuit interrupters (GFCI), surge protective device (SPD), isolated ground (IG) and tamper resistant (TR).
2. AC Wall Switches: Single- and double-pole, three- and four-way, maintained and momentary, pilot light and lighted toggle.
3. Device Wall Plates.
4. Service/Power Poles and Multi-Outlet Assemblies.
5. Emergency Power Off Buttons

1.2 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. IG: Isolated Ground

C. PIR: Passive Infrared.

D. RFI: Radio Frequency Interference

E. SPD: Surge Protective Device

F. USB: Universal Serial Bus

G. TR: Tamper Resistant

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.

B. Product data for the following products:

1. Provide manufacturer’s catalog information specifically marked to indicate which devices are being furnished, and showing dimensions, colors, and configurations for all devices, including, but not limited to: Receptacles, AC wall switches, cover plates, power poles, and multi-outlet assemblies.

C. Shop drawings for:

1. List of legends and description of materials and process used for pre-marking wall plates.

D. Samples:

1. One for each type of device and wall plate specified, in each color specified.
2. Samples will be returned after review, and, if accepted by the Architect and Engineer, may be installed on the Project.

E. Field quality-control test reports.

Warranty: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated cover plate from a single manufacturer and through one source. Where practical and possible, obtain all wiring devices and associated cover plates from a single manufacturer and one source.

B. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 10 years.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
2. Marked for intended use.

D. Comply with NFPA 70.

1.5 COORDINATION

A. Receptacles for Equipment Furnished by Owner or Under Other Divisions or Contracts: Match plug configurations.

1.6 EXTRA MATERIALS

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

1. Wall Plates: One for every 10 of each type (i.e., style, size, and finish) installed, but no fewer than two of each type.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

A. Wiring devices are defined as single discrete units of electrical distribution systems, such as convenience receptacles, switches, special purpose receptacles, and similar, which are intended to carry, but not use electrical energy. Install wiring devices as required by the Specifications and where indicated on the Drawings.

2.2 MANUFACTURERS

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

1. Receptacles and Switches:

    a. Cooper Wiring Devices.
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Mfg. Company Inc.
    d. Pass & Seymour/Legrand; Wiring Devices Div.

2. Multioutlet Assemblies:

    a. Hubbell Incorporated; Wiring Device-Kellems.
    b. Wiremold Company (The).

3. Service/Power Poles:

    a. Hubbell Incorporated; Wiring Device-Kellems.
    b. Pass & Seymour/Legrand; Wiring Devices Div.
    c. Square D/Groupe Schneider NA.
    d. Thomas & Betts Corporation.
    e. Wiremold Company (The).

4. Emergency Power Off Buttons:

    a. GE Industrial.
    b. Square D/Groupe Schneider NA.
    c. Eaton.

B. In other Part 2 articles below, where lists of manufacturers and device catalog numbers are included, the following additional requirements apply to product selection:

1. Additional Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers listed in individual articles below, in addition to those listed in Paragraph “Manufacturers” above.

2.3 FINISHES

A. Color:

1. Wiring devices connected to normal power systems: White, unless otherwise indicated or required by NFPA 70. Cover plates: Stainless Steel.

2. Wiring devices connected to emergency power systems: Cover plates: Stainless Steel and engraved with “EMERGENCY POWER” with black filler in the engraving. Engrave the panelboard designation and circuit number serving the emergency device into the cover plate.

B. Manufacturer's model numbers listed are to establish the quality of the wiring devices. Coordinate the proper suffixes in order to provide the correct color as specified above.

2.4 CONVENIENCE RECEPTACLES:

A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide receptacles equivalent to those specified for 20A, but rated for 15A.

B. Duplex convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex	Single
Cooper	5362	5351
Hubbell	5352A	HBL5361
Leviton	5352	5261
Pass & Seymour	5362	5361

C. Duplex convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	CR20
Hubbell	BR20

Leviton	CR20
Pass & Seymour	CR20

D. Duplex tamper resistant convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	TR5362
Hubbell	HBL8300SGA
Leviton	8300-SGG
Pass & Seymour	TR5362

E. Duplex tamper resistant convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	TRCR20
Hubbell	BR20TR
Leviton	TBR20
Pass & Seymour	TR20

F. Duplex weather resistant convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	TWR270
Hubbell	5362WR
Leviton	WBR20
Pass & Seymour	WR5862

G. Duplex weather resistant convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex

Cooper	WRBR20
Hubbell	5362WR
Leviton	WBR20
Pass & Seymour	WR20TRW

H. Twist-Locking type receptacles: NEMA L5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, self-grounding.

Manufacturer	Single
Cooper	L520R
Hubbell	HBL2310
Leviton	2310
Pass & Seymour	L520-R

I. USB/duplex convenience receptacles: NEMA 5-20R, 125V, 20A, tamper resistant, 3-wire, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding; with integral USB charger having two ports, USB 2.0 compatible, 5VDC, 3A output (min).

Manufacturer	Single
Cooper	TR7756
Hubbell	USB20X2
Leviton	T5832
Pass & Seymour	TR5362USB

J. USB-charging-only convenience receptacles: 125V, 20A, 3-wire, grounding type, UL 1310 listed and labeled, smooth nylon face, side and back wired, self-grounding; with integral USB charger having four ports, USB 2.0 and 3.0 compatible, 5VDC, 4.2A output (min).

Manufacturer	Single
Cooper	7750
Hubbell	USB4
Leviton	USB4P
Pass & Seymour	TM8USB4

K. Automatically Controlled receptacles: Where indicated on drawings, provide device type from other applicable category, along with marking for controlled receptacles as required by the current version of the NEC. In the case where the NEC is not applicable to the project, the device shall still be provided with this marking. In that case, the NEC is providing the standard for the marking and this specification is requiring it to be marked above and beyond the application of the code.

2.5 GFCI RECEPTACLES

A. Ground fault circuit interrupter type receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

Manufacturer	Specification Grade
Cooper	VGF2
Hubbell	GF20LA
Leviton	T7899-H
Pass & Seymour	2095

B. Ground fault circuit interrupter type weather-resistant receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

Manufacturer	Specification Grade
Cooper	WRVGF20
Hubbell	GFTR20
Leviton	W7899
Pass & Seymour	2095TRWR

2.6 ISOLATED GROUND RECEPTACLES

A. Isolated ground receptacles: Heavy Duty Specification grade [NEMA 5-20R][NEMA L5-20R], 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, furnished with a green pigtail connected to the grounding contact, and grounding contacts electrically isolated from the mounting strap.

Manufacturer	[Straight Blade]	[Locking]
Cooper	IG5362	IGL520R
Hubbell	IG5352	IG2310
Leviton	5362-IG	2310-IG
Pass & Seymour	IG5362	N/A

B. Isolated ground receptacles: Commercial Specification grade NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, furnished with a green pigtail connected to the grounding contact, and grounding contacts electrically isolated from the mounting strap.

Manufacturer	Duplex
Cooper	IG5362
Hubbell	IG20CR
Leviton	5362-IG
Pass & Seymour	IG5362

C. Isolated ground receptacles: Hospital Grade NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, furnished with a green pigtail connected to the grounding contact, and grounding contacts electrically isolated from the mounting strap.

Manufacturer	Duplex
Cooper	IG5362
Hubbell	IG8362SA
Leviton	8300-IG
Pass & Seymour	IG8300

2.7 SPECIAL/MISCELLANEOUS DEVICES

A. Special purpose receptacles: Grounding type, UL listed with NEMA configurations as indicated below or on the Drawings.

Manufacturer	Dryer 14-30R	Range 14-50R	Switch/Receptacle	Clock 5-15R
Cooper	1257	1258	--	TR775
Hubbell	HBL9430A	HBL9360	--	HBL5235
Leviton	278	279	5225	5261-CH
Pass & Seymour	3864	3849	671	S3733

2.8 SWITCHES

A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide switches equivalent to those specified for 20A, but rated for 15A.

B. Switches: Heavy Duty Specification grade, rated for 120/277V, 20A, back and side wired, and UL listed and labeled.

Manufacturer	1 Pole	2 Pole	3 Way	4 Way
Cooper	AH1221	AH2221	AH3221	AH4221
Hubbell	1221	1222	1223	1224
Leviton	1221-2	1222-2	1223-2	1224-2
Pass & Seymour	CSB20AC1	CSB20AC2	CSB20AC3	CSB20AC4

C. Switches: Commercial Specification grade, rated for 120/277V, 20A, back and side wired, and UL listed and labeled.

Manufacturer	1 Pole	2 Pole	3 Way	4 Way
Cooper	CSB120	CSB220	CSB320	CSB420
Hubbell	DS120	DS220	DS230	DS330
Leviton	CSB1-20	CSB2-20	CSB3-20	CSB4-20

Pass & Seymour	CS20AC1	--	CS20AC3	--

D. Pilot Light switches: 20A, single pole switch with red led lighted handle. Toggle shall be illuminated when the switch is in the "ON" position.

Manufacturer	1 Pole	2 Pole	3 Way
Cooper	AH2221PL	AH222PL	AH2223PL
Hubbell	HBL1221PL	HPL1222PL	HBL1223PL
Leviton (120V)	1221-PLX	1222-PLX	1223-PLX
Leviton (277V)	1221-7PLX (277V)	1222-7PLX	1223-7PLX
Pass & Seymour	PS20AC1-XSL	PS20AC2-XSL	PS20AC3-XSL

E. Key operated light switches: Same as standard light switches except toggle handle shall be operated by a factory provided key.

Manufacturer	1 Pole	2 Pole	3 Way	4 Way
Cooper	221L	2222L	2223L	2224L
Hubbell	HBL1221L	HBL1222L	HBL1223L	HBL1224L
Leviton	1221-2KL	122202KL	1223-2KL	1224-2KL
Pass & Seymour	PS20AC1-L	PS20AC2-L	PS20AC3-L	PS20AC4-L

F. Switches for use with mechanically-held, electrically-operated lighting contactors: Single pole, double throw, momentary, center off switch, rated for 120/277V, and UL listed and labeled.

Manufacturer	1 Pole
Cooper	1995
Hubbell	HBL1557
Leviton	1257-I
Pass & Seymour	1251

2.9 DUAL VOLTAGE SWITCH RELAY

A. A normally-open, electrically-held relay that allows a single-pole switch to control loads operating at two different voltages (e.g., 120V and 277V); listed to UL Standard 916; installed in a 2-gang outlet box, with a voltage-separating barrier and plaster ring.

Manufacturer	Model Number
Lighting Controls and Design	GR 2001 DV – [X]

2.10 COVER PLATES

A. Damp Location Weatherproof Receptacle Cover Plates: UL-listed Wet Location (cover closed, not in use); die-cast, gasketed (factory-installed) self-closing covers, for horizontal or vertical] mounting:

Manufacturer	[Horizontal]	[Vertical]
Cooper	1966	966
Hubbell	RW51020	RW51040
Leviton	4990	4978
Pass & Seymour	4511	4512

A. Wet Location Weatherproof Receptacle Cover Plates (Outlet Box Hood): NEMA 3R weather resistant recessed or flush mount, die cast aluminum lockable cover. Configure cover for horizontal mounting of receptacle or as indicated otherwise. Back box must be suitable for conduit connections. Coordinate back box with wall depth.

Manufacturer	Horizontal
Thomas & Betts	CKMU
Eaton	WIUMV-1
Hubbell	WP26MH
Leviton	IUM1H-GY

B. Damp and Wet Location Weatherproof switch cover plates: Fabricated of cast aluminum or cast zinc, sealed water-tight and UL listed for wet locations.

Manufacturer	1 Gang	2 Gang
Appleton	FSK	--
Raco	5100 Series	--
Steel City	SW Series	--

C. Other locations: Single and combination types to match corresponding wiring devices and manufacturer of wiring devices specified herein.

1. Plate securing screws: Metal with head color to match finish plate.

2. Material for Finished Spaces: Brushed stainless steel Type 302.
3. Material for Unfinished Spaces and surface mounted wiring devices: Galvanized steel.
4. Masonry walls and oversized wall openings: Jumbo size plates with same material as indicated above.

2.11 MULTI-OUTLET ASSEMBLIES

A. Surface type "plug-in" strips:Steel 3-wire, single circuit with single grounding type, 15A, 125V receptacles, pre-wired on 12-inch centers. Provide all fittings, devices, end closures, elbows, boxes and conduit entrance fittings as required for a complete installation.

Manufactur	[Steel]
Hubbell	HBL 20GB Series
Wiremold	--
Wiremold	AMDTP-4 Series

2.12 EMERGENCY POWER OFF BUTTONS

A. Push Button Operators: 30MM, watertight/oiltight, heavy duty, 600V maximum ac/dc, 10A continuous, momentary, non-illuminated, shrouded push button operator. Provide with 1 normally open and 1 normally closed contact block.

Manufacturer	Red Button

Schneider	9001KR1RH13
GE Industrial	CR104PBG91R3
Eaton	10250T5021

B. Push/Pull Button Operators: 30MM, watertight/oiltight, heavy duty, 600V maximum ac/dc, 10A continuous, 2 position maintained, non-illuminated, push/pull button operator. Provide with 1 normally open and 1 normally closed contact block.

Manufacturer	Red Button
Schneider	9001SKR9RH13
GE Industrial	CR104PBM91R5C
Eaton	10250T5B621

C. Break Glass Operators: 30MM, watertight/oiltight heavy duty, 600V maximum ac/dc, 10A continuous, push button operator that when disk is broken the operator is released to its open position.. Provide with 1 normally closed contact block, surface or recess mounted, NEMA 1, 4, 4X enclosure with integral break glass hammer and chain.

Manufacturer	
Schneider	9001K15
Eaton	10250TBG

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install all wiring devices plumb, level, and square with building lines. Wiring device bodies shall extend to the finished surface of the walls, ceiling or floor, as applicable, without projecting beyond them.

C. Connect wiring devices by wrapping conductors around screw terminals. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor and bond to metal outlet box. Exception: Do not bond grounding terminals of isolated ground receptacles to the outlet box.

E. Install devices shown on wood trim, cases or other fixtures symmetrically and, where necessary, set with the long dimensions of the plate horizontal, or ganged in tandem.

F. Unless dimensioned otherwise, install wiring devices a minimum of 24 inches from the closest edge of any sink.

G. Install switches with OFF position down.

H. Install cover plates on all switches, receptacles, and blank outlets.

I. Locate wiring devices so that the cover plate does not have to be cut to be installed.

J. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.

K. Install cover plates after the wall has been finished (painted, wall paper, etc).

L. Install device boxes in brick or block walls such that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

M. Provide specification grade receptacles in all other areas unless otherwise noted.

N. Provide safety-type, tamper-resistant receptacles in all areas where receptacles are mounted less than 5’-6” AFF and are easily accessible to children.

O. Provide safety-type, tamper-resistant receptacles in psychiatric patient rooms. Provide tamperproof screws on faceplates of all wiring devices in psychiatric patient rooms.

P. Provide engraved nameplate on emergency off buttons.

Q. Provide ground fault circuit interruption capability for all 120V receptacles 50A or less and all 208/240V receptacles 100A or less in code required locations. Locations include, but are not limited to: bathrooms, kitchens/food prep areas, exterior locations and within 6’ or sinks. Interruption capability can be achieved via a GFCI circuit breaker or a GFCI receptacle.

R. Provide type and quantity of normally open and/or normally closed contacts for emergency off buttons to meet the sequence of operations shown.

S. Install wiring devices shown back-to-back on a common wall offset a minimum of 12" horizontally to reduce sound transmission between rooms.

3.2 GENERAL

A. Outlets are only approximately located on the small scale Drawings. Use great care in the actual location by consulting the various large scale detailed Drawings used by other Division trades, and by securing definite locations from the Architect.

B. Do not use multi-conductor circuits, with a shared neutral, for any GFCI receptacle circuit. Provide a separate neutral conductor with all GFCI receptacle circuits.

C. Provide twist-locking type receptacles or other special type receptacles where indicated on the Drawings.

3.3 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Verify that outlet boxes are installed at proper height and are flush with the finished surface.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

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

3.4 PREPARATION

A. If required, provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from in and around outlet boxes.

3.5 MOUNTING HEIGHTS

A. Coordinate locations of outlet boxes provided under Division 26 Section "Common Work Results for Electrical".

B. Unless noted otherwise, install wiring devices at mounting heights indicated in the Electrical Symbols Legend on the construction drawings.

1. Receptacles:

a. General:

1) Unless indicated otherwise, install vertically with the ground slot mounted at the top.
2) Where Installed horizontally, install neutral slot mounted at the top.

b. Above counters:

1) Mount vertically.

c. Mechanical and electrical equipment rooms and janitors closets:

1) Mount horizontally.

d. Garages:

1) Wet location: Mount horizontally.
2) Other locations: Mount vertically.

e. Weatherproof exterior receptacles:

1) Mount horizontally.

f. GFCI receptacles: Same as general receptacles.
g. Isolated ground receptacles: Same as general receptacles.
h. SPD receptacles: Same as general.
i. Concrete Block Walls: Dimensions above may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom or top of boxes, as applicable, are at block joints.

2. Switches:

a. Above counters: Same as for receptacles.
b. Concrete Block Walls: Dimension may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom of boxes are at block joints.

c. Walls with wainscoting: 6 inches minimum above wainscoting, but not exceeding 48 inches above finished floor.

3. Multi-outlet assemblies:

a. 6 inches above counter top.

4. Telephone/Data Outlet Boxes:

a. General: Match mounting height of adjacent wiring device listed above.

5. Emergency Power Off Buttons and Break Glass Operators:

a. General: Match requirements of switches listed above.

b. Wall-mounted telephone: 40 inches above finished floor.

3.6 IDENTIFICATION

A. Label all devices fed down stream of GFCI protected receptacles as “GFCI PROTECTED”.

B. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles and Switches: Identify panelboard and circuit number from which served, using:

a. Hot, stamped or engraved machine printing with black-filled lettering on face of plate.
b. Durable wire markers or tags inside outlet boxes.
c. Permanent-ink marker, hand-printed legibly, inside outlet boxes.
d. Adhesive film label, but with letter/number height of 1/4 inch, on face of plate.
e. Adhesive Film Label with Clear Protective Overlay, but with letter/number height of 1/4 inch, on face of plate, for exterior and damp/wet locations.

3.7 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.

D. Test all wiring devices for electrical continuity and proper polarity of connections.

E. Test each GFCI receptacle device for proper operation.

F. Correct wiring devices incorrectly installed.

G. Repair or replace all damaged items or damaged finishes at no expense to the Owner.

3.8 ADJUSTING

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

3.9 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in:

   a. Control circuits
   b. Enclosed switches
   c. Panelboards
   d. Switchboards
   e. Enclosed controllers
   f. Motor-control centers.

2. Plug fuses rated 125-V ac and less for use in plug-fuse-type:

   a. Enclosed switches
   b. Fuseholders
   c. Panelboards.

3. Spare-fuse cabinets.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper if available.
5. Coordination charts and tables and related data.

6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. All items requested under “Product Data”.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.4 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C)]or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 EXTRA MATERIALS

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

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholers or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

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

C. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

D. Install spare-fuse cabinet(s).

3.2 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.3 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance:

a. Greater than 600A:

1) Class L, time delay

b. 600A or less:

1) Class RK1, time delay

2. Feeders:

a. Greater than 600A:

1) Class L, time delay

b. 600A or less:

1) Class RK1, time delay

3. Motor Branch Circuits:

a. Class RK1 time delay

4. Other Branch Circuits:

a. Class RK1, time delay

5. Control Circuits:

a. Class CC fast acting

3.4 END OF SECTION

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

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

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

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

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

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

1. Fuses: Equal to 10percent of quantity installed for each size and type, but no fewer than three each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

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

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

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

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

B. Type HD, Heavy Duty, Single Throw, 240V or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

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

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

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

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

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-poweredtype with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Alarm Switch: One [NO] [NC] contact that operates only when circuit breaker has tripped.
6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

7. Zone-Selective Interlocking: Integral with [electronic] [ground-fault] trip unit; for interlocking ground-fault protection function.
8. Electrical Operator: Provide remote control for on, off, and reset operations.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1
2. Outdoor Locations: NEMA 250, Type 3

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

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

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

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

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

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Included in the work of this section are labor, material, and appurtenances required to complete the work of this Section as specified herein, including, but not limited to:

1. Interior light fixtures, lamps, LEDs, reflectors, lenses or faceplates, ballasts, transformers, drivers and power supplies (includes exterior light fixtures normally installed on exterior surfaces of buildings).
2. Emergency lighting units.
3. Exit signs.
4. Light fixture supports.
5. Emergency Lighting Mini-Inverter.
6. Coordination.
7. Quality assurances.
8. Specific requirements.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section "Exterior Lighting” for exterior light fixtures, except those normally mounted on exterior surfaces of buildings.

D. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

E. Division 26 Section "Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

F. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.3 SUBMITTALS

A. General:

1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, and approved in accordance with paragraph 1.4-SUBSTITUTIONS of this Section, or both, will be accepted. Where the Light Fixture Schedule indicates an allowance to be made for a specific light fixture, the price is a contractor price and monies shall be allotted for freight, installation, and lamping (if designated). Alternate manufacturers presented at bid shall be disqualified.
2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.
3. Prepare portfolios from manufacturer's standard specification sheets, and include the fixture tag indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
4. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
5. Modifications to fixtures shall be in accordance with Architect's comments.

B. Product Data: For each type of light fixture, collated and bound in sets, and arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Summary page with the following for each light fixture type

    a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
    b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.

2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.

    a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, fixture efficacy and/or efficiency, and verification of indicated parameters.
    b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.

        1) Include MacAdam ellipse step information for:

            a) All interior light fixtures

            b) Exterior luminaires installed on exterior building surfaces specified with 80 CRI or greater.

3. Light fixture mounting details, including non-standard outlet boxes.
4. Construction of light fixture housing and door (if applicable).
5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.

6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.

7. Ballast cut sheet for 150W to 500W metal halide ballasts. Cut sheet shall include information confirming that the ballast meets minimum ballast efficiency requirements set forth by EISA and indicated within this specification.
8. Light fixture finish and color (if applicable).

9. Air and Thermal Performance Data: For air-handling light fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
10. Sound Performance Data: For air-handling light fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 15 Section "Diffusers, Registers, and Grilles."

11. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.

    a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.

12. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.

    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

13. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.

C. Shop Drawings: Show details of non-standard or custom light fixtures. Indicate dimensions, finish color, including, but not limited to, custom color, weights, methods of field assembly, components, features, accessories, and modifications. Scaled documents shall be provided for custom fixtures.

D. Submittal Schedule

1. Within 30 days of Division 26 contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.
2. Within 15 days of "approved" and "approved as noted" shop drawings, contractor shall forward to Architect a guaranteed ship date for each specified fixture.
3. Within 15 days after contractor's receipt of "reject and resubmit" or "not approved" shop drawings, contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
4. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.

E. Control Wiring

F. Samples for Verification: For products designated for sample submission in Light Fixture Schedule, or at the request of Owner or Architect. Each sample shall include lamps, LEDs, ballasts and/or drivers. Sample shall be exact light fixture intended to be supplied for the project and equipped with 120-277V universal voltage and 120V cord and plug. Provide with pendant or wall support system if appropriate.

G. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

H. Qualification Data: For agencies providing photometric data for light fixtures.

I. Field quality-control test reports.

J. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.

K. Warranties: Special warranties specified in this Section.

1.4 SUBSTITUTIONS

A. Refer to Division 26 Section "General Electrical Requirements".

B. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the Light Fixture Schedule designation, name of the material or equipment for which it is to be substituted and complete Product Data for the proposed substitute, as defined in SUBMITTALS above, and all other information necessary for an evaluation. Provide interior point-by-point calculations, under both normal and emergency lighting conditions, as applicable, if required by the Engineer. Submit a $100.00 review fee to the Engineer with each such point-by-point

calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.

C. During the Bid

1. Any proprietary, sole-sourced light fixture listed in the fixture schedule shall be unit priced only. Unit prices shall be clearly identified on the bid form.
2. Representative agents shall be allowed to offer mini-lot pricing (MLP). MLP shall be defined as:
3. Agents can group only specified fixtures they represent, and
4. Only represent in the region where the specification originated, and
5. Exclude all fixtures outside their represented lines from the MLP, and
6. Sole-sourced (proprietary) light fixtures shall not be included in the MLP.
7. Packaging of light fixtures will not be considered nor approved. Packaging is defined as: distributor(s) providing a single price for a light fixture package made up of specified and non-specified light fixtures. Any submittal package containing non-specified light fixtures or inclusion of lighting control systems will be immediately rejected in its entirety.

D. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.

E. During the construction period, no substitutions shall be considered if product delay is due to contractor's failure to order products in a timely manner after presentation of fixture schedules and specifications. Additional costs associated with air freight or special factory runs to meet schedule due to contractor's error shall be at the expense of contractor.

F. The Architect/Engineer has the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

1.5 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature

C. CFL: Compact Fluorescent

D. CRI: Color-rendering index.

E. CU: Coefficient of utilization.

F. EISA: Energy Independence and Security Act of 2007.

G. HID: High-intensity discharge.

H. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs

I. LED: Light Emitting Diode

J. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.

K. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

L. LER: Light fixture (Luminaire) efficiency rating.

M. Light Fixture: Complete light fixture, including ballast housing if provided.

N. RCR: Room cavity ratio.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
2. Marked for intended use.

B. Comply with NFPA 70.

C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

E. Regulatory Agencies: Provide fixtures conforming to nationally- or internationally-recognized accredited testing agencies, such as U.S., ETL, ARL, or others in acceptance with local code enforcement policy.

F. Electrical Components and Devices: Provide only fixtures that comply with National Electric Code (NEC), and in particular to Section 410. All ceiling recessed fixtures, whether indicated in a catalog number or not, shall be equipped with an integral thermal protection device.

G. FMG Compliance: Light fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

H. Mockups: Provide interior light fixtures for room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of fixtures for mockups before starting installations. Costs shall not be added to the base bid if Owner or Architect does not approve mockup.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work and documenting of final conditions.

3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 COORDINATION

A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

B. Coordinate layout and installation of light fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including, but not limited to, HVAC equipment, fire-suppression system, and partition assemblies. Contractor shall arrange his installation in proper relation to other work so that there shall be no interference, damage or delay to other trades' work

C. Give ample notice of any special openings or rough-in work required for placing electrical/lighting work so as to avoid cutting or removal of completed work.

D. Where work of this Section is to be flush or concealed, install it so it does not project beyond finished lines of walls, ceilings or floor surface.

E. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

1.8 WARRANTY

A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.10.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects

in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.

B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.

C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.

1. LED Luminaires, including LED modules, arrays and drivers: Five years.
2. LED Lamps: Three years.

D. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining coverage years.
2. Warranty Period for Emergency Driver: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining coverage years.
3. Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

a. Warranty Period for Electronic Drivers: 5 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

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

1. Additional light fixtures and accessories as scheduled on the Drawings.

B. Where light fixtures are specified with tamper proof hardware, provide the Owner with three tools for each different type of hardware.

1.10 SPARES

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

1. Lamps: 10 for every 100of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Battery and Charger Data: Onefor each emergency lighting unit.
4. Ballasts and/or Drivers: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In Light Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each light fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.

2.2 LIGHT FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Provide light fixtures as shown on the drawings and/or specified. This shall include all lamps, material and labor to securely hang light fixtures, clean them and make them completely ready for use. Provide all hangers, supports, and miscellaneous hardware required to install light fixtures. Provide additional tie wires connected to structure to conform to applicable seismic requirements where required.

B. Light fixture models scheduled on the Drawings are to show the manufacturer, grade and style of light fixtures required. Regardless of the manufacturer's catalog number suffixes indicated, provide all options and features as described in the Light Fixture Schedule.

C. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures. Manufacturer of recessed fixtures shall provide mounting brackets suitable for connection to ceiling system structure. Modifications to standard mounting brackets shall be coordinated with contractor and delivered with fixture so that no delays to product delivery shall be allowed.

D. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A. Minimum gauge of sheet steel to be 18 gauge.

E. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable. Minimum gauge of sheet steel to be 22 gauge.

F. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

G. Metal Parts: Free of burrs and sharp corners and edges.

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

I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

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

K. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
    b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

L. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.

M. Fixture Finishes:

1. Apply fixture finishes after fabrication in a manner that assures a durable wear-resistant surfacing. Give exposed metal surfaces (brass, bronze, aluminum and

others) and finished castings, except chromium-plated or stainless steel parts, an even coat of high-grade meth/acrylate lacquer or transparent epoxy.

2. For corrosive or salt water environments, manufacturer shall provide fixtures with low copper/zinc cast aluminum (AB-47100 aluminum with less than 0.6% copper – classified for corrosive areas) housings to prevent salts from “pitting” aluminum housing. Manufacturer shall provide, in addition to or in lieu of, AB-47100 aluminum, ion added or pre-anodized polyester powder cast finish for “marine grade” applications. Manufacturer shall otherwise provide all stainless steel housing in conjunction with stainless steel hardware.
3. Recessed downlights in corrosive or salt water interior environments shall be equipped with a “natatorium” finish comprised of a zinc-chromated and phosphated process, then powder-coated on the exterior of the housing.

N. Reflectors:

1. Provide aluminum reflectors or reflecting cones for downlight style fixtures comprised of #12 aluminum reflector sheet, 0.57 inch (15 gauge) or heavier and free of tool-making indentations, including spinning lines caused by assembly techniques. All reflectors shall be of first-quality, anodized finish :Alzak” with specular or semi-specular finish and color as selected. Provide specular reflectors with no apparent brightness above 45 degrees from Nadir and semi-specular, diffuse reflectors with no apparent brightness above 75 degrees from Nadir.

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:

   a. "USE ONLY" and include specific lamp or LED type.
   b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
   c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires. Indicate maximum allowed wattage.
   d. LED type, wattage, beam angle (if applicable) for LED luminaires. Indicate maximum allowed wattage.
   e. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
   f. ANSI ballast type (M98, M57, etc.) for HID luminaires.
   g. CCT and CRI for all luminaires.

P. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate light fixtures with one filter on each ballast indicated to require a filter.

Q. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 15 Section "Diffusers, Registers, and Grilles."

1. Air Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
2. Heat Removal Units: Air path leads through lamp cavity.
3. Combination Heat Removal and Air Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air supply units.
4. Dampers: Operable from outside fixture for control of return-air volume.
5. Static Fixture: Air supply slots are blanked off, and fixture appearance matches active units.

R. Luminaires supplied with 150W to 500W metal halide lamps and ballasts shall contain a capital E printed in a circled on the ballast label and the fixture packaging per EISA requirements.

2.3 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.
b. Charger: Fully automatic, solid-state type with sealed transfer relay.
c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

3. Master/Remote Sign Configurations:

a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in [LED power supply] [ballast] [battery] for power connection to remote unit.
b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

C. Self-Luminous Signs: Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for [10] [15] [20] years.

D. Self-Luminous Signs: Using strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Provide with universal bracket for flush-ceiling, wall, or end mounting.

2.4 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

7. Integral Time-Delay Relay: Holds unit on for fixed interval of [15] <Insert period> minutes when power is restored after an outage.

8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.5 DRIVERS FOR LED LUMINAIRES

A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Power Factor: 0.90 or higher at full load.

5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
6. Driver shall operate with maximum sustained variations of +/-[10] <Insert value>% input voltage and frequency with no damage to driver.
7. Driver output shall be regulated to maximum +/- 5% published load range or requirements of downstream LED fixture.
8. LED Current Crest Factor: 1.5 or less.
9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
10. Meets EN610000 for input harmonics.
11. ROHS Compliant.

B. Dimming Drivers:

1. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:

   a. Luminaires: 100 to 10 percent of rated lumens.
   b. Lamps: 100 to 20 percent of rated lumens.

2. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and LED indicated.
4. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.6 EMERGENCY LIGHTING MINI-INVERTER

A. Manufacturer

1. Basis-of-Design Product: [Insert manufacturer name from below] is the Basis-of-Design manufacturer. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified below:

    a. Iota Engineering #IIS Series
    b. Cooper Lighting Surelites #CMFT Series
    c. Highlites #PFT Series

B. Description – Self-contained uninterruptible or fast-transfer inverter designed for normal and emergency operation of connected lighting loads. Unit shall be capable of operating HID, incandescent, fluorescent, induction and LED fixtures with no break or interruption of illumination. UL 924 listed and meets NFPA 101, NEC and local codes.

1. Battery: Sealed, maintenance-free lead-calcium or lead-acid type. 68 deg F to 86 deg F optimum operating temperature.
2. Charger and Electronics: Fully automatic, thermal compensating variable rate battery charger. AC lockout feature, low battery voltage disconnect; DC overload, short circuit and brownout protection. 32 deg F to 104 deg F electronics operating temperature.
3. Operation: Inverter shall allow connected emergency lighting fixtures to be normally on. Upon loss of normal utility power, the emergency lighting fixtures will be delivered emergency power for their full lumen output rating with no break (<2 ms) in illumination for a minimum of 90 minutes.
4. 120V, single phase input and output voltages. Input voltage shall match output voltage, and +/- 3% voltage regulation, 60 Hz.
5. Maximum remote mounting distance of 1000'-0".
6. Housing: Designed for surface mounting installation to floor or wall. 16 gauge steel housing with scratch-resistant powder coat paint finish..
7. Testing: Integral testing means by either manual test switch or self-testing, self-diagnostic with manual testing capabilities.
8. Onboard LED indicating lights for inverter status indication.
9. Manufacturer's warranty or minimum 2 year warranty on electronics and battery and seven-year prorata warranty on battery, whichever is greater.
10. Overload and short circuit protection on input and output of inverter. Circuit breakers or fusing on output side.

C. Where wattage of inverter is different from Basis-of-Design manufacturer's selected wattage, provide quantity of inverters as required to meet design intent. If additional inverters are required, confirm additional equipment will fit within available space constraints.

D. Where physical size of inverter is different from Basis-of-Design manufacturer, confirm equipment will fit within available space constraints.

2.7 LAMPS GENERAL

A. Unless specific manufacturers and lamp types are called for in the Light Fixture Schedule, all lamps provided for this project shall be by the same manufacturer. Lamps shall be manufactured by:

1. Eiko
2. General Electric
3. Osram/Sylvania
4. Philips
5. Soraa
6. Venture

B. All lamps shall be new and shall be delivered to the project in manufacturer's original sealed package.

C. Substitutions of specific lamp manufacturer as addressed in Fixture Schedule shall not be allowed. Costs associated with re-lamping due to non-compliance with specification, for both labor and material costs, shall be the sole responsibility of the contractor. For those fixtures with lamp included in fixture, contractor shall coordinate with manufacturer to ensure only approved lamp(s) is (are) installed. Lamp manufacturers indicated on Fixture Schedule are for reference. Where required, contractor shall coordinate with Owner regarding national purchasing agreement of specific lamp manufacturers. Purchasing of lamps, whether through competitive bidding of listed manufacturers or proprietary supply, shall be at the discretion of the Owner.

2.8 INCANDESCENT/ QUARTZ AND LOW VOLTAGE LAMPS

A. Standard A-line lamps above 1100 lumens shall not be allowed. Only “watt-miser” reduced wattage lamps or halogen versions such as BT-15 or TB19 lamps shall be acceptable. Wattages above 250 watts for standard incandescent A-line lamps shall be used on a specific need basis only for existing liturgical fixtures or otherwise demdanded for decorative fixture. Standard A-line lamps with wattages above 150 watts shall not be used for downlight purposes unless required for MRI installations or installations requiring non-harmonic functioning sources.

B. Medium based 50 watt PAR20 lamps shall not be used. Either reduced wattage or “IR” technology versions of said lamp shall be used. For the remaining PAR lamps, standard lamping shall be replaced by silver-backed or “IR” technology lamps. Extended life PAR lamps shall be excluded from the requirement. R7S base single contact linear quartz lamps above 300 watts shall be required to use the “IR” technology versions of said lamp with the same base and maximum overall length.

C. 75 watt MR-16 lamps shall not be allowed. 71 watt and 65 watt MR-16 lamps, unless protective glass lens cannot be allowed, shall be replaced by 50 watt (or lower wattage) “IR” MR-16 lamps instead. No standard, non-dichroic backed MR-16 lamps with rated life of 2000 hours shall be allowed under any circumstance.

D. Incandescent lamps shall be guaranteed for 30 days from the date of final acceptance and during this period, shall be replaced, upon failure, at no cost to the Owner.

2.9 LED LAMPS AND LUMINAIRES

A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 80 CRI minimum and 3500 CCT.

B. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values or as indicated in the Light Fixture Schedule, whichever is more stringent. All LEDs used for same fixture type throughout the project to originate from same production bin.

C. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% maintained initial-rated lumens at average rated life of as follows:

1. LED lamps: 20,000 hours
2. LED luminaires: 50,0000 hours

D. ROHS compliant

E. Manufacturer of LED chips will be evaluated based on the manufacturer's product literature and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Cree, Nichia, Osram or Xicato LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desireable.

2.10 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system. Where equipment is not indicated as plenum rated, provide an additional enclosure for the device(s) suitable for the installed environment.

2.11 LIGHT FIXTURE SUPPORT COMPONENTS

A. Comply with Sections "260548 Seismic Controls for Electrical" and "260529 - Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

EXECUTION

2.12 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

2.13 INSTALLATION

A. Light Fixtures: All work shall be executed to present a neat appearance. Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Support for Light Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from light fixture corners.
2. Support Clips: Fasten to light fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

4. Install at least one independent support rod or wire from structure to a tab on light fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Light Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end. Provide suitable connectors or collars to connect adjoining units to appear as a continuous unit.
4. Decorative pendant mounted light fixtures

    a. Provide cord and/or stem lengths to match elevations above finished floor as indicated on architectural elevations. If architectural elevations do not indicate suspension heights, coordinate with Architect to determine final suspension heights. Regardless, contractor shall not field cut pendants or order rigid stems without elevation approval from Architect. Pendant suspensions on electrical documents are for reference only.

        1) Cord-mounted: Manufacturers shall supply luminaires with flexible, field cutting cords. Contractor shall field cut cords as required.
        2) Field-cuttable, rigid-stem mounted: Manufacturers shall supply luminaires with field cutting rigid stems. Contractor shall field cut stems as required.
        3) Factory-cut rigid stem mounted: Contractor shall provide rigid stem dimensions to the manufacturer as required.

    b. Junction boxes used to feed light fixtures shall be covered by manufacturer supplied canopy plates.

E. Installation within non-standard ceilings, including, but not limited to, wood and metal ceilings.

1. For recessed downlight light fixtures, specification is based on standard throats to accommodate ceiling thicknesses of ¾" or less. If non-standard ceiling (such as wood, thickened gypboard ceilings and metal plank type) require throats greater than ¾", modifications to manufacturer's standard ¾" throat shall be determined by Architect and Contractor prior to shop drawing submission.
2. For light fixtures recessed into metal ceilings, rigidly support light fixture to ensure that trim fits flush with ceiling plane.

F. Air-Handling Light Fixtures: Install with dampers closed and ready for adjustment.

G. Manufacturer shall supply contractor with a complete list of component elements to comply with design intent for either 20-amp (flexible low voltage track systems or line voltage track) or 50-amp bus bar track systems. Contractor shall install track systems based on design requirements outlined herein or Light Fixture Schedule.

H. Connect wiring according to Section "260519 - Low-Voltage Electrical Power Conductors and Cables."

I. Through wiring of recessed light fixtures, in suspended ceilings, is not permitted. Connect each light fixture by a whip to a junction box. The whip shall be of sufficient length to allow the light fixture to be relocated within a 6-foot radius.

J. Wall Mounted Light fixtures

1. Unless otherwise noted, conceal all raceways and back boxes for wall mounted light fixtures. Coordinate all wall-mounted light fixtures with interior elevations. Where specific elevations or dimensions are not indicated, verify the correct location with Architect prior to installation. Contractor shall supply structure to support weight of fixture.

K. Contractor shall construct light coves according to architectural details. Contractor shall ensure, unless otherwise directed, that top of fixture lamp is flush with top of cove lip. Contractor shall provide blocking as needed under fixture to ensure stated requirement.

L. Auxiliary Devices for low voltage and LED Fixtures

1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
2. In public areas or other areas where remote device visibility is undesireable, install device where concealed from view, well ventilated and accessible. Provide access panels as required.
3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
4. Properly support remote lighting devices, including transformers, power supplies, and drivers, per Code and manufacturer's recommendations.

2.14 MULTI-LEVEL SWITCHING

A. For multi-level (step-dimming) drivers or ballasts, provide number of switch conductors required to the device for operation of all light levels intended.

B. The lighting design for this project has included multi-level (inboard/outboard) switching. Where indicated, 3-lamp light fixtures shall have the center lamp switched from the switch nearest the door and the outer 2 lamps switched from the other switch.

C. Where indicated, 4-lamp light fixtures shall have the outer 2 lamps switched from one switch and the center 2 lamps shall be switched from the other switch.

D. A similar multi-level lighting arrangement shall be provided where 4- and 3-way switches are shown. Where only one switch is shown at the alternate location it shall control the center lamp. Light fixtures indicated to have multi-level switching shall be furnished with the proper number of ballasts.

2.15 DIMMING

A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum,

provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:

1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
2. 2-Wire dimming – two line voltage conductors plus ground
3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
4. DALI – two low voltage conductors and two line voltage conductors plus ground
5. Proprietary digitally addressable – as required per the manufacturer
6. DMX – two line voltage conductors plus ground and DMX cabling

B. Coordinate light fixture and control device dimming types for compatibility.

2.16 COORDINATION

A. Light fixtures shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings for exact locations.

B. Coordinate the installation and location of light fixtures with other work and all other trades before installation to avoid conflicts. Coordinate light fixture locations in mechanical rooms with final installed piping and ductwork layouts.

C. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

D. Wall-Mounted Light fixtures

1. Coordinate all wall-mounted light fixtures with the architectural features of the building. Where specific elevations or dimensions are not indicated, verify the correct location with the Architect prior to beginning any work.

2.17 ADJUSTING

A. Contractor shall adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

B. At the time of substantial completion, aim all track lights, flood lights, spot lights, and other fixtures requiring aiming per the Architect's direction. Contractor shall make provisions for supplying all scaffolds, lifts, and other tools and equipment as required.

C. Where required, focusing shall be done during hours of darkness. Upon notification by contractor that all fixtures are correct as per shop drawings and functioning, that specified lamps have been verified, lighting designer or Architect shall coordinate with contractor as to a mutually agreed upon time to complete focusing. Failure of contractor to notify Architect during substantial completion will result in failure to comply with specifications.

2.18 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

C. Upon completion of the installation of light fixtures, and after building circuits have been energized, energize lighting branch circuits to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

D. At the time of final acceptance of this project by the Owner, ensure that all lamps are in working order and all light fixtures are fully lamped.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

2.19 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION

SECTION 265600 - EXTERIOR AREA LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting equipment:

1. Exterior LED light fixtures with LED modules and drivers.
2. Light-fixture-mounted photoelectric relays.
3. Poles and accessories.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section “Grounding and Bonding for Electrical Systems”

D. Division 26 Section “Raceway and Boxes for Electrical Systems.

E. Division 26 Section “Underground Ducts and Raceways for Electrical Systems”

F. Division 26 Section “Vibration and Seismic Controls for Electrical Systems”

G. Division 26 Section “Indentification for Electrical Systems”

H. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

I. Division 26 Section "Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

J. Division 26 Section "Wiring Devices" for devices installed in poles.

K. Division 26 Section “Fuses”

L. Division 26 Section “Enclosed Switches and Circuit Breakers”

M. Division 26 Section “Lightning Protection for Structures”

N. Division 26 Section “Interior Lighting” for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 SUBMITTALS

A. General:

1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, and approved in accordance with paragraph 1.4-SUBSTITUTIONS of this Section, or both, will be accepted. Where the Light Fixture Schedule indicates an allowance to be made for a specific light fixture, the price is a contractor price and monies shall be allotted for freight, installation, and lamping (if designated). Alternate manufacturers presented at bid shall be disqualified.
2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.

B. Prepare portfolios from manufacturer's standard specification sheets, and include the number indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.

1. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
2. Modifications to fixtures shall be in accordance with Architect’s comments.

C. Product Data: For each light fixture, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Summary page with the following for each light fixture type

a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.

2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.

a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, effective projected area, fixture efficacy and/or efficiency, and verification of indicated parameters.
b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.

1) Include MacAdam ellipse step information for luminaires specified with 80 CRI or greater.

3. Light fixture mounting details, including, but not limited to, non-standard outlet boxes.
4. Construction of light fixture housing and door (if applicable).
5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.

    a. For dimming ballasts, also include dimming type technology and dimming range/limits.

6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.

    a. For dimming LED, also include dimming type technology and dimming range/limits.

7. Ballast cut sheet for 150W to 500W metal halide ballasts. Cut sheet shall include information confirming that the ballast meets minimum ballast efficiency requirements set forth by EISA and indicated within this specification.

8. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.

    a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.

9. Details of attaching light fixtures and accessories.
10. Details of installation and construction.
11. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.

    a. For indicated light fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining light fixtures shall be certified by manufacturer.
    b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

12. For pole-mounted LED area lighting fixtures, IES-TM-21 LED luminaire lifetime and lumen maintenance projections.
13. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.

14. Photoelectric relays.
15. Materials, dimensions, and finishes of poles.
16. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.
17. Anchor bolts for poles.

18. Manufactured pole foundations.

1.4 SUBSTITUTIONS

A. Refer to Division 26 Section “General Electrical Requirements”.

B. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the Light Fixture Schedule designation, name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including cut sheets, photometric data, and all other information necessary for an evaluation. Provide interior point-by-point calculations if required by the Engineer. Submit a $100.00 review fee to the Engineer with each such point-by-point calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.

C. During the Bid

1. Any proprietary, sole-sourced light fixture listed in the fixture schedule shall be unit priced only. Unit prices shall be clearly identified on the bid form.
2. Representative agents shall be allowed to offer mini-lot pricing (MLP). MLP shall be defined as:

    a. Agents can group only specified fixtures they represent, and
    b. Only represent in the region where the specification originated, and
    c. Exclude all fixtures outside their represented lines from the MLP, and
    d. Sole-sourced (proprietary) light fixtures shall not be included in the MLP.

3. Packaging of light fixtures will not be considered nor approved. Packaging is defined as: distributor(s) providing a single price for a light fixture package made up of specified and non-specified light fixtures. Any submittal package containing non-specified light fixtures or inclusion of lighting control systems will be immediately rejected in its entirety.

D. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.

E. The Architect/Engineer have the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be

rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

1.5 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature

C. CFL: Compact Fluroescent

D. CRI: Color-rendering index.

E. CU: Coefficient of utilization.

F. CV: Coefficient of Variance. The ratio of standard deviation for all illuminance values to the mean illuminance value.

G. Delegated-Design Submittals: Documents, including, but not limited to, drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and authorities having jurisdiction.

H. EISA: Energy Independence and Security Act of 2007.

I. HID: High-intensity discharge.

J. Horizontial Illuminance: Measurement in foot-candles (lux), on a horizontal surface 36 inches above the ground, unless otherwise indicated.

K. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs

L. LED: Light Emitting Diode

M. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.

N. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

O. LER: Light fixture efficacy rating.

P. Light fixture: Complete light fixture, including ballast housing if provided.

Q. LLD: Lamp Lumen Depreciation.

R. LLF: Light Loss Factor.

S. Luminaire: Complete lighting fixture, including ballast housing if provided.

T. Pole: Light fixture support structure, including tower used for large area illumination.

U. Standard: Same definition as "Pole" above.

V. Target Illumination: Average maintained illumination level, calculated by multiplying initial illuminace by LLF.

W. UG: Uniformity Gradient; the rate of change of illuminance over a lighted area, expressed as a ration between the illuminances of adjacent measuring points on a uniform grid.

X. Vertical Illuminance: Measurement in foot-candels (lux), in two directions on a vertical surface, at an elevation coinciding with plane height of horizontal measurements.

1.6 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of light fixture and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in latest AASHTO LTS-4.

B. Live Load: Single load of 500 lbf, distributed as stated in latest AASHTO LTS-4.

C. Ice Load: As stated in latest AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent.

D. Wind Load: As stated in latest AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintainance repairs.

1. Manufacturer’s responsibilities include fabricating sports lighting and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of delegated-design submittals and comprehensive engineering analysis by a qualified professional engineer.

C. Light Fixture Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

D. Light Fixture Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

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

F. Comply with IEEE C2, "National Electrical Safety Code."

G. Comply with NFPA 70.

1.8 COORDINATION

A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

B. Coordinate layout and installation of light fixtures, poles, foundations, and underground raceway system with other above- and below-grade site construction and utilities. Notify Architect/Engineer of conflicts before proceeding with the Work.

1.9 WARRANTY

A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.12.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.

B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.

C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.

1. LED Luminaires, including LED modules, arrays and drivers: Five years.
2. LED Lamps: Three years.

D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Light fixtures: Free from defects in materials and workmanship (excluding fuses and lamps) for a period of 5 years from date of Substantial Completion.

2. Warranty Period for Metal Corrosion: Free from defects in materials and workmanship for a period of 10 years from date of Substantial Completion.
3. Warranty Period for Color Retention: Free of fading for a period of 5 years from date of Substantial Completion.
4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
5. Warranty Period for Poles: Repair or replace light poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than 10 years from date of Substantial Completion.

6. Warranty for Pole-Mounted LED Area Lights: Light fixture (including LEDs and drivers) and pole will be free of defects in material and workmanship for a period of ten years from date of product purchase.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below ground line.

D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation.

E. Retain factory-applied pole wrappings on metal poles until right before pole installation.

F. Handle all poles with web fabric straps.

1.11 EXTRA MATERIALS

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

1. Additional light fixtures, poles, and accessories as scheduled on the Drawings.

B. Where light fixtures are specified with tamper proof hardware, provide the Owner with three tools for each different type of hardware.

1.12 SPARES

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

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Ballasts and/or Drivers: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Furnish at least one of each type.
4. Fuses: 10 for every 100 of each type and rating installed.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In Light Fixture Schedule (on the drawings) where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each light fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 LIGHT FIXTURES, GENERAL REQUIREMENTS

A. Light fixtures shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for light fixtures.

C. Comply with IES BUG ratings where indicated on the Light Fixture Schedule.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

H. Exposed Hardware Material: Stainless steel for latches, fasteners, and hinges.

I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

J. Light Shields: Metal baffles or louvers, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

L. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.

M. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.

N. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping. Where indicated, match finish process and color of pole or support materials.

O. Factory-Applied Finish for Steel Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As indicated on the Light Fixture Schedule.

P. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

    a. Color: As indicated on the Light Fixture Schedule.

Q. Luminaires supplied with 150W to 500W metal halide lamps and ballasts shall contain a capital E printed in a circled on the ballast label and the fixture packaging per EISA requirements.

R. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:

    a. “USES ONLY” and include specific lamp or LED type.
    b. Lamp diameter code (T-4, T-5, T-8), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

d. LED type, wattage, beam angle (if applicable) for LED luminaires. Include maximum allowed wattage.
e. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
f. ANSI ballast type (M98, M57, etc.) for HID luminaires.
g. For LED luminaires, includes CCT and CRI.

2.3 BALLASTS GENERAL

A. General: Whenever possible, provide all ballasts by the same manufacturer for Owner's ease of maintenance. Ballasts by a different manufacturer may be acceptable where required to meet project requirements.

B. Unless specific manufacturers and ballast types are called for in the Light Fixture Schedule, ballast provided for this project shall be manufactured by:

1. Fluorescent Ballasts (Linear and Compact Fluorescent)

a. Non-Dim:

1) Advance, a divison of Philips – Optanium Series (linear) and SmartMate Series (CFL)
2) Fulham (cold-temperature CFL)
3) G.E.
4) Osram/Sylvania
5) Robertson (cold-temperature CFL)
6) Universal

2. HID ballast:

a. Magnetic:

1) Advance, a divison of Philips
2) G.E.
3) Osram/Sylvania
4) Universal

b. Electronic

1) Advance, a division of Philips
2) Aromat
3) Fulham
4) Hatch

2.4 LAMPS GENERAL

A. Unless specific manufacturers and lamp types are called for in the Light Fixture Schedule, all lamps provided for this project shall be by the same manufacturer. Lamps shall be manufactured by:

1. Eiko
2. General Electric
3. Osram/Sylvania
4. Philips
5. Soraa
6. Venture

B. All lamps shall be new and shall be delivered to the project in manufacturer's original sealed package.

C. Substitutions of specific lamp manufacturer as addressed in Fixture Schedule shall not be allowed. Costs associated with re-lamping due to non-compliance with specification, for both labor and material costs, shall be the sole responsibility of the contractor. For those fixtures with lamp included in fixture, contractor shall coordinate with manufacturer to ensure only approved lamp(s) is (are) installed. Lamp manufacturers indicated on Fixture Schedule are for reference. Where required, contractor shall coordinate with Owner regarding national purchasing agreement of specific lamp manufacturers. Purchasing of lamps, whether through competitive bidding of listed manufacturers or proprietary supply, shall be at the discretion of the Owner.

2.5 DRIVERS FOR LED LUMINAIRES

A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Power Factor: 0.90 or higher at full load.
5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
6. Driver shall operate with maximum sustained variations of +/- 10% input voltage and frequency with no damage to driver.
7. Driver output shall be regulated to +/- 5% published load range.
8. LED Current Crest Factor: 1.5 or less.
9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.

10. Meets EN610000 for input harmonics.
11. ROHS Compliant.
12. Suitable for use in outdoor light fixtures.
13. Dimming Drivers

    a. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
       2) Luminaires: 100 to 10 percent of rated lumens.
       3) LED Lamps: 100 to 20 percent of rated lumens.
    b. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
    c. Compatibility: Certified by the manufacturer for use with specific dimming control system and LED indicated.
    d. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.6 LED LAMPS AND LUMINAIRES

A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 70 CRI minimum and 4000K CCT. Additionally, color-important light fixtures, as indicated with 80 CRI or better the Light Fixture Schedule shall be 80 CRI minimum and 3500K. All LEDs used for same fixture type throughout the project to originate from same production bin.

B. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values for color as indicated in the Light Fixture Schedule.

C. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% of maintained initial-rated lumens at the average rated life as follows:

   1. LED outdoor pole mounted area lights: 100,000 hours
   2. LED lamps: 20,000 hours
   3. Other LED luminaires: 50,0000 hours

D. ROHS compliant

E. Manufacturer of LED chips will be evaluated based on the manufacturer's product literate and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Nichia, Cree, Xicato or Osram LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desireable.

2.7 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system.

2.8 LIGHT FIXTURE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay

1. Relay with locking-type receptacle shall comply with NEMA C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.9 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of light fixtures and brackets by a factor of 1-.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Light Fixture Attachment Provisions: Comply with light fixture manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M or ASTM A 153/A 153M unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, 3000-psi (28-day minimum compressive strength, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to

ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, light fixture(s), and accessories.

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.10 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: [Round, tapered] [Round, straight] [Square, tapered] [Square, straight][As indicated in the Light Fixture Schedule].

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: [Single-arm] [Truss] [Davit][As indicated in the Light Fixture Schedule] type, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Light Fixtures: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole and bracket, then bolted together with [stainless] [galvanized]-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate light fixture.
3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support light fixture or light fixtures and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.

G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

I. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.

J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

K. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

L. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As indicated in the Light Fixture Schedule.

2.11 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: As indicated in the Light Fixture Schedule.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support light fixture or light fixtures and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Light fixtures: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate light fixture.

2. Finish: Same as light fixture.

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: As indicated in the Light Fixture Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

3.2 LIGHT FIXTURE INSTALLATION

A. Install lamps in each light fixture.

B. Fasten light fixture to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust light fixtures that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.]Baffles and Louvers for Spill Light Correction: Install on lighting fixtures with fasteners provided by the manufacturer. Install and adjust to correct out-of-limit spill-light measurements.

D. Install controls and remote ballast or driver housings in cabinets mounted on support structure at least 10 feet above finished grade.

E. Auxiliary devices for low voltage and LED fixtures installation

1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
2. In public areas or other areas where remote device visibility is undesireable, install device where concealed from view, well-ventilated and accessible. Provide access panels as required.
3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
4. Properly support remote lighting devices, including, but not limited to, transformers, power supplies, and drivers, per Code and manufacturer's recommendations.
5. Provide enclosures suitable for installation environment as required.

3.3 MULTI-LEVEL SWITCHING

A. For multi-level (step-dimming) drivers or ballasts, provide number of switch conductors required to the device for operation of all light levels intended.

3.4 DIMMING

A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:

1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
2. 2-Wire dimming – two line voltage conductors plus ground
3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
4. DALI – two low voltage conductors and two line voltage conductors plus ground
5. Proprietary digitally addressable – as required per the manufacturer
6. DMX – two line voltage conductors plus ground and DMX cabling

B. Coordinate light fixture and control device dimming types for compatibility.

3.5 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of light fixtures and their mounting provisions on the pole. Install poles and other structural units level, plumb, and square.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches.
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
3. Trees: 15 feet.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space. Grout materials, installation, and finishing requirements are specified in Division 05 Section “Metal Fabrications”.
3. Install base covers, unless otherwise indicated.
4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Dig holes large enough to permit use of tampers in the full depth of hole.
2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Make holes 6 inches in diameter larger than pole diameter.
2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
4. Cure concrete a minimum of 72 hours before performing work on pole.

G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.

H. Raise and set poles using web fabric slings (not chain or cable).

3.6 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LIGHT FIXTURES

A. Install on concrete base with top 4 inches above finished grade or surface at light fixture location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.7 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems", including use of coated conduits in concrete foundations.

3.8 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting light fixture to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.9 FIELD QUALITY CONTROL

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

B. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

C. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

D. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

E. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect's direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.

F. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.

G. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

H. Illumination Tests Areas other than Sports Playing Fields:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
b. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
c. IESNA LM-64, "Photometric Measurements of Parking Areas."
d. IESNA LM-72, "Directional Positioning of Photometric Data."

3.10 CORRECTION OF DEFICIENCIES

A. Correction of Illumination Deficiencies: Make corrections to illumination quality or quantity measured in field quality-control tests that vary from specified illumination criteria by plus or minus 10 percent or more; add or replace lighting fixtures, or change mounting height, revise aiming, or install louvers, shields, or baffles. If lighting fixtures are added or mounting height is changed, revise aiming and recalculate and modify or replace support structures, if indicated. Retest as specified above after repairs, adjustments, or replacements are made. Report results in writing.

B. Correction of Excessive Illumination in Spill-Light-critical Areas: If measurements indicate that specified limits for spill light are exceeded, make corrections to illumination quantity measured in field quality-control tests that reduce levels to within specified maximum values. Replace lighting fixtures, or change mounting heights, revise aiming, or install louvers, shields, or baffles. Obtain Architect's approval to replace luminaires with units of higher or lower wattage. If mounting height is changed, revise aiming and recalculate and modify or replace support structures, if indicated. Retest as specified above after repairs, adjustments, or replacements are made. Report results in writing.

C. Exterior athletic lighting will be considered defective if it does not pass tests and inspections.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain light. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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DIVISION 27 - COMMUNICATIONS

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SECTION 270010 - GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and to all following sections within Division 27.

1.2 SECTION INCLUDES

A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.

B. Division 27 of these Specifications, and Drawings numbered with prefix T, generally describe these systems, but the scope of the Communications Work includes all such Work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing, Electrical and Telecommunications Drawings and Specifications; and Addenda.

C. Drawings are graphic representations of the Work upon which the Contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of Work, indicating the intended general arrangement of the equipment, fixtures, outlets and cabling without showing all of the exact details as to elevations, offsets, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

1.3 ABBREVIATIONS AND ACRONYMS

A. ADA Americans with Disabilities Act

B.	AFF	Above Finished Floor
C.	AHJ	Authority Having Jurisdiction
D.	ANSI	American National Standards Institute
E.	ASTM	American Society for Testing and Materials
F.	BICS	Building Industry Consulting Service International
G.	ETL	Electrical Testing Laboratories, Inc.
H.	FCC	Federal Communications Commission
I.	FM	Factory Mutual
J.	GE	Grounding Equalizer
K.	IEEE	Institute of Electrical and Electronic Engineers
L.	LED	Light Emitting Diode
M.	NEC	National Electric Code
N.	NESC	National Electrical Safety Code
O.	NEMA	National Electrical Manufacturers Association
P.	NFPA	National Fire Protection Association
Q.	NRTL	Nationally Recognized Testing Laboratory
R.	OEM	Original Equipment Manufacturer
S.	OFCI	Owner Furnished Contractor Installed
T.	OSHA	Occupational Safety and Health Administration
U.	OSP	Outside Plant
V.	RCDD	Registered Communications Distribution Designer
W.	TBB	Telecommunications Bonding Backbone
X.	TGB	Telecommunications Grounding Bus-bar
Y.	TIA	Telecommunications Industries Association
Z.	TMGB	Telecommunications Main Grounding Bus-bar

AA. UL Underwriters Laboratories

BB. UON or UNOUnless Otherwise Noted

1.4 DEFINITIONS

A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:

1. AHJ - The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
2. Approved Equivalents or Equal - For specific products, materials, equipment, or systems for which this Division specifically identifies the Contractor shall use as the basis for their bid. Where the term approved equivalent or equal is listed the contractor may submit documentation for review by the Design Consultant for approval. The Design Consultant's acceptance or rejection is final.
3. As Directed - means as directed by the Contract Administrator, or his representative.
4. Communications Room - means the location of a floor-serving facility for housing telecommunication equipment, cable terminations, and cross-connect wiring, as well as those for audio video systems and potentially other low-voltage systems such as security and fire alarm (electronic safety and security). This room is recognized in ANSI/TIA-569 as the transition point between the telecommunications horizontal (station) pathway facilities and the backbone (riser) pathway facilities.
5. Concealed - means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, or installed within hung ceilings.
6. Conditionally Approved – the manufacturer has been found reputable by the design professional, but the design professional has not verified that the product offering by manufacturer meets to all specification requirements. Contractor shall adhere to submittal review process for final approval on products.
7. Contract Administrator: Where referenced in this Division, "Contract Administrator" is the primary liaison between the Owner and the Contractor. Specifically, for this project this is "the Owner's Representative".
8. Design Consultant - Where referenced in this Division, "Design Consultant" is the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Contract Administrator, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Design Professional, in addition to involvement by, and obligations to, the "Contract Administrator".
9. Furnish - "To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
10. Furnished by Owner (or Owner-Furnished) or Furnished by Others: "An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper

installation and operation. Include the installation under the warranty required by this Division.

11. Install - “To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use.”
12. NRTL - Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTL’s that are acceptable to the AHJ, and standards that meet the specified criteria.
13. Provide - “To furnish and install complete, and ready for the intended use.”
14. Submit - means submit to Contract Administrator for review.
15. Substitution - means a product meeting all requirements and specifications and having been approved by the Design Consultant to replace another product specifically identified herein.
16. Wet Location - means a pathway that does not protect cables from moisture levels that are beyond the intended operating range of “inside” premises cable.

    a. For example: Slab-on-grade construction where pathways are installed underground or in concrete slabs that are in direct contact with soil (e.g., sand and gravel) is considered a “wet location.”
    b. Also refer to the:

        1) Telecommunications Distribution Methods Manual (TDMM) for definitions of Wet locations

17. (*) – Where appearing in product part or model numbers; shall represent wild card character to be filled in by the contractor to meet required specifications.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Design Consultant as equivalent to the item or manufacturer specified”.

C. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

1.5 REFERENCE STANDARDS

A. Execute all Work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of Work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules,

and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator's and Design Consultant's attention in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.

B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Contract Administrator and Design Consultant, without additional compensation. Contractor will be held responsible for any violation of the law.

C. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.

D. All material, manufacturing methods, handling, dimensions, methods of installation and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them.

E. The references to the following codes, references and standards represent the most current and up-to-date revisions or printing as of the issue of this document including all sections, parts and their addenda. The Contractor is responsible for following the latest revision or printing (UON):

1. ANSI/TIA-569 – "Commercial Building Standard for Telecommunications Pathways and Spaces"
2. NFPA 70 – National Electrical Code (NEC)
3. IEEE National Electrical Safety Code (NESC)
4. Americans with Disabilities Act (ADA) of 1990, as amended

1.6 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with other Divisions for Communications work to be included but not listed in Division 27 or indicated on Communications Drawings.

B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any Work covered by this Division.

C. Refer to Communications Drawings and Divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Follow

these drawings as closely as the actual construction and the work of other trades will permit. Provide all offsets, fittings, and accessories, required to clear equipment, beams and other structural members which may be required but not shown on the Drawings.

D. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. Maintain a project manager, as specified by the Quality Assurance sections of these specifications, on the jobsite at all times to coordinate this Work with other trades so that various components of the Communications systems are installed at the proper time, fits the available space, allows proper service access to all equipment, and meets all required codes and standards.

F. Carry on the Work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.

G. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.

H. Carefully check space requirements with other trades to ensure that equipment can be installed in the spaces allotted.

I. Refer to Coordination requirements in specific sections for additional information.

J. Examine and compare the Contract Drawings and Specifications with the Drawings and specifications of other trades, and report any discrepancies between them to the Contract Administrator and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

K. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit these drawings to the Contract Administrator for review. At completion include a set of these drawings with each set of Record Drawings.

L. Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections shall be made or which shall be changed or altered.

M. In cases of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Contract Administrator.

1.7 MEASUREMENTS AND LAYOUTS

A. The Drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional cost to the Owner, errors that could have been avoided by proper checking and inspection.

1.8 SUBMITTALS

A. Refer to Division 1 and General Conditions for general submittal requirements. Refer to individual Division 27 Sections for additional submittal requirements. Unless otherwise noted, it is recommended to submit electronically in PDF format.

B. Submittals and shop drawings shall not contain Henderson Engineers' firm name or logo, nor shall it contain the Engineer of Record's seal and signature. They shall not be photocopies or reproductions of Henderson Engineers' work product. If the contractor desires to use elements of such product, the license agreement for transfer of information at the end of this section shall be used.

C. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

D. Unless noted otherwise within each individual section, submittals shall be provided for approval in four distinct phases:

1. Pre-bid

    a. Required no less than two weeks prior to the due date for the submission of bids, such as:

        1) Product substitutions, approved alternate or equivalent requests to be reviewed for approval (Prior to Bid)
        2) Alternate personnel credentials to be reviewed for approval
        3) And as required by individual sections in this Division

2. Bid

    a. Required at the time of the submission of bids, such as:

        1) Bid Response Forms
        2) Unit Pricing (if required by sections in this Division)
        3) Personnel Qualifications
        4) Contractor Qualifications (Previous project references)
        5) Voluntary Bid Alternates
        6) And as required by individual sections in this Division

3. Pre-construction

    a. Required after the award of the project to the winning bidder and prior to starting construction.
    b. Submit the following items no longer than four weeks after receiving the notice to proceed:

        1) Division of Labor amongst sub-contractors. Include:

            a) Company Name
            b) Address
            c) Name of project manager for this project, including:

                i) E-mail
                ii) Telephone number

        2) Construction schedule showing important milestone dates and activities. Schedule shall be coordinated with overall project construction schedule.
        3) Updated Personnel and Contractor Qualifications where different from those submitted during the Bid phase.
        4) A typed list, indexed by Specification section, of products specifically identified by part number (no wild card characters) within each specification section in this Division. Products are to be listed in the same order as in the specification. List is to include length of manufacturer warranty for each product.
        5) Manufacturers' cut-sheets:

            a) Cut-sheets are to be in the same order as in the specification sections.
            b) At a minimum all cut-sheets shall contain the following:

                i) Cross-reference to the specification section and/or drawings for which the product is to be reviewed for compliance and acceptance
                ii) Every product cut-sheet submitted for review shall contain the manufacturers' name and logo somewhere on the page
                iii) All parts, pieces, and equipment submitted for review shall be clearly identified by stamp, markup, or highlight in such a manner that the product(s) being submitted are clearly identifiable and distinguished from all other materials, parts, or equipment that may be on the submittal.
                iv) For cut-sheets with accessories, additional parts, or derivations of the product being submitted, all shall be clearly identified for the reviewer and acceptance.

v) Sufficient detail for reviewer to identify all required information, such as size, weight, color, NRTL listings, approval or certification information, and other necessary identifying information to confirm product meets specifications.

6) Samples – refer to individual sections for specific sample requirements.

a) Samples requested shall be physical examples that represent materials, equipment or workmanship and establish standards by which the work will be judged. Contractor or Manufacturer shall cover all associated fabrication and shipping costs.

c. Submit the following items sufficiently prior to installation of each respective portion of work:

1) Shop Drawings

a) Shall be furnished per the requirements of each Division 27 specification Section.

4. Project Completion

a. Required after the substantial completion but prior to final approval for completion, such as:

1) Record Drawings
2) Operation and Maintenance Data
3) Project test reports
4) Cable Databases (as applicable)
5) Warranty Certificate(s)
6) Lead Installer / Project manager letter with signature stating the project has been installed in accordance with referenced industry standards and contract documents.
7) And as required by individual sections in this Division

E. Refer to Division 01 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Design Consultant that the shop drawings have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name, and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator and Design Consultant's designated representatives. Contractor shall allow the Design Consultant review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the electronic submittal and shall clearly indicate the materials, performance criteria and accessories

being proposed. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

F. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as materials or paint finish.

G. Provide submittals in sufficient detail to demonstrate compliance with these Contract Documents and the design concept.

H. Transmit submittals as early as required to support the project schedule. Allow for two weeks Design Consultant review time, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before construction starts.

I. No part of the work shall be started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted and accepted.

J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions, or for deviations from the requirements of the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superseded in any way by the review of shop drawings, product data and samples.

L. Submittals shall contain the following information. Submittals not so identified will be returned to the Contractor without action:

1. The project name
2. The applicable Specification Section and paragraph
3. The submittal date
4. The submitting (sub-)contractor's company name and the project manager's name and contact information.

M. Include dimensional data for roughing in and installation and technical data sufficient to verify that equipment meets the requirements of the Contract Documents. Include wiring, piping and service connection data.

N. The Design Consultant's checking and subsequent acceptance of such submittals shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Design Consultant's and Contract

Administrator's attention to such deviations at the time of submission, and secured written acceptance; nor shall it relieve the Contractor from responsibility for errors in dimensions, details, sizes of members, or quantities; or for omissions of components or fittings; or for not coordinating items with actual building conditions and adjacent work.

O. The work described in shop drawing submissions shall be carefully checked by all trades for clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and coordination with other trades on the job. Each submitted shop drawing shall include a certification that related job conditions have been checked by the Contractor and each Subcontractor and that conflicts do not exist.

P. Maintain a complete set of reviewed and stamped shop drawings and product data on site.

Q. Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.

1.9 SUBSTITUTIONS

A. Refer to Division 1 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:

1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Contract Administrator, and Owner the following:

    a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    c. Proposed substitution has received necessary approvals of the Authorities Having Jurisdiction.
    d. Same warranty will be furnished for proposed substitution as for specified Work.

e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:

1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
2. No substitutions will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
3. If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet.

B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.

C. Contact the Contract Administrator for written authorization.

D. The following must be received before electronic drawing files will be sent:

1. Contract Administrator’s written authorization
2. Engineer’s release agreement form
3. Payment

1.11 QUALITY ASSURANCE

A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.

B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all

equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.

C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

1.12 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Contract Administrator, for Engineer’s review, and for the Owner’s use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Contract Administrator and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Contract Administrator’s and Engineer’s designated representatives.

1.13 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections of this Division.

1.14 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Contract Administrator.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Contract Administrator.

D. Be responsible for the safe storage of tools, material and equipment.

1.16 WARRANTIES

A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

C. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer's standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.

D. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.

E. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.

F. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.17 TEMPORARY FACILITIES

A. Refer to Division 1 and General Conditions for Temporary Facilities requirements.

B. Temporary Utilities: The types of services required include, but are not limited to, electricity, telephone, and internet. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

1.18 FIELD CONDITIONS

A. Conditions Affecting Work In Existing Buildings: The following project conditions apply:

1. The Drawings describe the general nature of remodeling to the existing building; however, visit the Site prior to submitting bid to determine the nature and extent of work involved.
2. Schedule Work in the existing building with the Owner.
3. Perform certain demolition work prior to the remodeling. Perform the demolition that involves Communications systems, equipment, raceways, equipment supports or foundations and materials.
4. Remove articles that are not required for the new Work. Unless otherwise indicated, remove each item removed during this demolition from the premises and dispose in accordance with applicable federal, state and local regulations.
5. Relocate and reconnect Communications facilities that shall be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where communications equipment or materials are removed, cap unused raceways below the floor line or behind the wall line to facilitate restoration of finish.

6. Obtain permission from the Contract Administrator for channeling of floors or walls not specifically noted on the Drawings.
7. Protect adjacent materials indicated to remain. For Work specific to this Division, install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
8. Locate, identify, and protect Communications services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services shall be interrupted, provide temporary services for affected areas.

B. Conditions Affecting Excavations: The following project conditions apply:

1. Maintain and protect existing building services that transit the area affected by selective demolition.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

D. Use of explosives is not permitted.

E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s instructions.

3.2 EXISTING CONDITIONS

A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site

observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new Work.

B. Verify all actual existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.

3.3 EXISTING UTILITIES

A. Existing utility services not specifically indicated to be removed or altered shall remain as they presently exist.

B. Where existing services interfere with demolition or construction, alter or reroute such existing equipment to facilitate demolition or construction after obtaining written permission from the Contract Administrator. Notify in writing giving two weeks advance notice or planned alteration prior to altering any existing condition is required.

C. Schedule and coordinate with the utility company, Owner and with the Contract Administrator all connections to, relocation of, or discontinuation of normal services from any existing service provider line. Include all premium time required for all such work in the Bid.

D. Preserve continuity of service of existing facilities (related to damage or alteration due to new construction). Unauthorized alteration to existing equipment shall be corrected without additional cost to the Owner.

E. Repair all existing utilities damaged due to construction operations to the satisfaction of the Owner or Utility Company without additional cost.

F. Do not leave utilities disconnected at the end of a workday or over a weekend unless authorized by representatives of the Owner or Contract Administrator.

G. Make repairs and restoration of utilities before workmen leave the project at the end of the workday in which the interruption takes place.

H. Include in Bid the cost of furnishing temporary facilities to provide all services during interruption of normal utility service.

3.4 WORK IN EXISTING FACILITIES

A. The Drawings describe the general nature of remodeling to the existing facilities; however, visit the Site prior to submitting a Bid, to determine the nature and extent of Work involved.

B. Schedule Work in the existing facility with the Owner.

C. Certain demolition work shall be performed prior to the remodeling. Perform the demolition that involves communications systems, conduit, wiring, equipment, equipment supports or foundations and materials.

D. Remove all of these articles that are not required for the new Work. Unless otherwise indicated, each item removed during this demolition shall be removed from the premises and disposed of in accordance with all state and local regulations.

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

1. Notify Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of communication service.
2. Do not proceed with interruption of communication service without Contract Administrator and the Owner's written permission.
3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.

F. Reconnect communication circuits serving equipment required to remain in service to other cable termination fields, patch panels or splices as indicated on the Drawings or as appropriate. Provide additional cable and termination hardware where there is insufficient available capacity in remaining existing equipment for reconnection.

G. Relocate and reconnect all communications facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where communications devices or equipment are removed, cap all unused raceways behind the floor line or wall line to facilitate restoration of finish, and, remove all existing wiring from abandoned raceways.

H. Finish materials are specified in other divisions.

I. Where removal of existing wiring interrupts continuity of communication circuits that are to remain in use, provide necessary wiring, raceways, junction boxes, etc., to ensure continued communication continuity.

J. Channel walls and floors as required to produce the desired result; however, obtain permission from the Contract Administrator for all channeling not specifically noted on the Drawings.

3.5 PERMITS AND FEES

A. Secure and Pay all required fees and obtain all required permits related to the Communications Infrastructure installation.

B. Pay royalties or fees in connection with the use of patented devices and systems.

3.6 SELECTIVE DEMOLITION

A. Refer to Division 01, Division 02, and General Conditions for Selective Demolition requirements.

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

C. Materials and Equipment to Be Salvaged:

1. Communications Infrastructure equipment to be removed that is in good working order shall be carefully removed and offered to the Owner. Items rejected by the Owner shall be removed from the project site and legally and properly disposed of.
2. Remove, demount, and disconnect existing communications materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

D. Remove existing conduit and wire back to the Communications Equipment room, unless a specific extent of removal is indicated on the Drawings.

E. Communications Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete raceways, fittings, supports and specialties, equipment, wiring, controls, fixtures, and insulation:

a. Raceways and outlets embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Cut embedded raceways to below finished surfaces, seal, and refinish surfaces as specified or as indicated on the Architectural Finish Drawings. Remove materials above accessible ceilings. Cap raceways allowed to remain.
b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and “Cutting and Patching” portion of this Section in Division 27.

3.7 ACCESS TO EQUIPMENT

A. Locate all pull boxes, junction boxes and controls so as to provide easy access for operation, service inspection and maintenance. Provide an access door where equipment or devices are located above inaccessible ceilings. Refer to Division 26 Section “Common Work Results for Electrical”.

B. Maintain all code required clearances and clearances required by manufacturers.

3.8 PENETRATIONS

A. Unless otherwise noted as being provided under other divisions, provide sleeves, box frames, or both, for openings in floors, walls, partitions and ceilings for all electrical work that passes through construction. Refer to Division 27 Section “Common Work Results for Communications”.

B. Provide sleeves, box frames, or both, for all conduit, cable, and cable trays that pass through masonry, concrete or block walls.

C. The cutting of new and/or existing construction will not be permitted except by written approval of the Contract Administrator.

3.9 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02 and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this division. Excavation shall be in conformance with applicable Divisions and sections of the Specifications.

C. Restore roads, alleys, streets and sidewalks damaged during this work to the satisfaction of Authorities Having Jurisdiction.

D. Do not excavate trenches close to walks or columns without prior consultation with the Contract Administrator.

E. Erect barricades around excavations, for safety, and place an adequate number of amber lights on or near the work and keep those burning from dusk to dawn. Be responsible for all damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.

F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

    1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of one inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches for electrical installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of six to nine inches clearance on both sides of raceway and cables.
2. Excavate trenches to depth indicated or required for raceway and cables to establish slope, away from buildings and indicated elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which raceway and cables can be installed, tested, and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceway and cables. Provide a minimum of six inches of stone or gravel cushion between rock bearing surface and raceway and cables.
5. Excavate trenches for raceway, cables, and equipment with bottoms of trench to accurate elevations for support of raceway and cables on undisturbed soil.

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

N. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under raceway and cables, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For raceway and cables less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of raceway and cables, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
5. Other areas use excavated or borrowed materials.

O. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

P. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

1. For vertical and diagonal raceway installations, thoroughly support raceways from permanent structures or undisturbed earth at no less that 10-foot intervals, while placing backfill materials, so that raceways are not deflected, crushed, broken, or otherwise damaged by the backfill placement.

Q. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

R. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

S. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined

moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

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

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

3.10 CUTTING AND PATCHING

A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.

B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.

C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.

D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.

E. Patch around openings to match adjacent construction, including fire ratings, if applicable.

F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.11 PAINTING

A. Refer to Division 09 Section “Painting” for painting requirements.

B. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.

C. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer’s instructions for pre-cleaning surfaces and application.

D. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.

E. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

3.12 CLEANING

A. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to final inspection, make a final cleanup of dirt and refuse resulting from Work and assist in making the premises vacuum clean. Clean all material and equipment installed under this Division.

C. Remove dirt, dust, plaster, stains, and foreign matter from all surfaces.

D. Touch up and restore damaged finishes to their original condition.

E. All communications equipment shall be thoroughly vacuumed and wiped clean prior to startup and at the completion of the project. Equipment shall be opened for observation as required.

3.13 ADJUSTING, ALIGNING AND TESTING

A. Adjust, align and test all equipment furnished and/or installed under this Division.

B. Check and test protective devices for specified and required application, and adjust as required.

C. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.

D. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor or both.

E. Refer to individual Sections for additional and specific requirements.

3.14 START-UP OF SYSTEMS

A. Prior to start-up of each system, check all components and devices to confirm compliance with manufacturers' recommended installation procedures.

B. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.

C. Refer to individual Sections for additional and specific requirements.

3.15 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:

1. Submit results of systems tests and adjustments per each individual section.
2. Submit complete Operation and Maintenance Data.
3. Submit complete Record Drawings.
4. Perform all required training of Owner's personnel.
5. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
6. Perform start-up tests of all systems.
7. Remove all temporary facilities from the site.
8. Comply with all requirements for Substantial Completion in the Division 1 and General Conditions.

B. Request in writing a review for Substantial Completion and scheduling of final acceptance. Provide a minimum of five (5) business days notice prior to the review for project sites within a 4-hour drive from the office where the design was created; provide a minimum of eight (8) business days notice for sites beyond a 4-hour drive.

C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, then provide reimbursement to the Contract Administrator and Design Consultant for time and expenses incurred for the visit.

F. Upon completion of the review, the Contract Administrator and Design Consultant will prepare a “final list” of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the “final list” shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

3.16 EARLY OCCUPANCY

A. Failure to meet the Substantial Completion date can result in the Owner needing to take early occupancy. Complete the systems which are necessary to allow partial early occupancy of the building by original Substantial Completion date.

1. Refer to individual sections for additional requirements.

B. Verify and comply with requirements for temporary occupancy with the local Building and Fire Departments.

END OF SECTION 270010

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

A. This Section includes general construction materials and methods, communications equipment coordination, and common communications installation requirements for Division 27 systems as follows:

1. Grounding and Bonding for Communications
2. Pathways for communications systems.
    a. Cable Supports
    b. Conduit
    c. Outlet Boxes
    d. Pull Boxes
3. Firestopping Systems
4. Access Panels
5. Identification

1.2 RELATED REQUIREMENTS

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations in the following Sections: 27 Section “General Communications Requirements”

B. Division 07 Section “Penetration Firestopping” for fire stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

C. Division 26 for reference regarding materials and methods for additional requirements.

D. Division 27 “General Communications Requirements”

1.3 DEFINITIONS

A. AV – Audio Video

B. Cable Tray System – A unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways.

C. Common Work – all Work specified in this section.

D. Conduit Body – A separate portion of a conduit or tubing system that provides access through a removeable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system. Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies.

E. Conveniently Accessible – Capable of being reached from the floor or via the use of an 8 foot step ladder without crawling or climbing over or under obstacles such as piping, duct work, motors, transformers, pumps, etc.

F. Firestopping System – Firestopping products that have been specifically tested and rated by a Nationally Recognized Testing Laboratory (NRTL), such as UL, to provide the required flame (F), fire and temperature (T), air and smoke (L), and water (W) containment for a given partition/penetration.

G. Floor Box Assembly (Floor Box) – An on-grade solution or above grade (with a native fire classification or in combination with an approved Firestopping System) solution for in-floor terminations. The Assembly consists of pour pan (as applicable), Firestopping System (as applicable), floor box (compartment), plate mounting brackets, line voltage divider plates, termination plates, termination connectors, electrical receptacle(s), gang plates (termination cover plates), and access door / cover / lid.

H. Ground or Grounding – A conducting connection, whether intentional or accidental, between an electrical circuit (e.g. telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.

I. IMC – Intermediate Metal Conduit

J. Plenum – A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

K. Plenum-rated – A product that is listed by a NRTL as being suitable for installation into a plenum space.

L. Point of Entrance (Building Entrance) – The point within a building where the Outside Plant (OSP) communications cabling emerges from an external wall, a concrete floor slab, or IMC/RMC. If Communications Point of Entrance isn't identified on the drawings, assume the Main Communications (MDF) also acts as the Point of Entrance.

M. Poke Through Assembly (Poke-Thru) – An above grade solution with a native fire classification for in-floor terminations. The Assembly consists of pre-pour sleeve (as applicable), Firestopping System, fire resistant conduit stub, poke thru (compartment), plate mounting brackets, line voltage divider plates, termination plates, termination connectors, electrical receptacle(s), gang plates (termination cover plates, as applicable), and access door / cover / lid.

N. Quality Control Specialist – as it pertains to Work within this section, Quality Control Specialist is the Project RCDD, as defined in Division 27 Section "Structured Cabling System", for Common Work for Telecommunications.

O. RMC – Rigid Metal Conduit

P. Surface Metal Raceway – A metallic raceway that is intended to be mounted to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors.

Q. Surface Nonmetallic Raceway – A nonmetallic raceway that is intended to be mounted to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors.

R. UL – Underwriters Laboratory

1.4 REFERENCE STANDARDS

A. Follow all applicable codes, references, guidelines, and standards listed in Division 27 Section “General Communications Requirements”.

B. Follow the additional codes, references, standards and guidelines:

1. ASTM E 814 and ANSI/UL1479 –“Fire Tests Through Penetration Firestops”
2. ASTM E 84 and ANSI/UL 723 “Surface Burning Characteristics of Building Materials”
3. ASTM E 119 and ANSI/UL 263 “Fire Tests of Building Construction Materials”

1.5 ADMINISTRATIVE REQUIREMENTS

A. Adjust location of conduits, terminal blocks, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication:

1. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.
3. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.

1.6 SUBMITTALS

A. Follow the requirements for submittals in Division 27 Section “General Communications Requirements”.

B. Bid Submittal

1. Contractor Qualifications for Firestopping Systems: Provide copies of training/certification as required in the Quality Assurance portion of this specification section.

C. Pre-construction Submittal

1. Manufacturers’ cut sheets or catalog cut sheets of each of the pathways not specifically identified by its exact part number:

a. In addition to Division 27 Section “General Communications Requirements”, include the following:

1) Size – including physical and loading dimensions
2) Maximum span length
3) Weight supported
4) Type
5) Fittings to be used
6) Method of attachment to structure
7) Firestop system assembly information for each system to be installed:

a) Documentation from UL catalog for each system proposed. This documentation shall include the following information:

i) Firestop manufacturer
ii) UL system number
iii) F, T, and L Ratings
iv) The complete description of the firestop system; To include what specific construction the system is intended to pass through such as a wall or floor assembly, the penetrating items allowed to pass through the opening in the wall or floor assembly, and the materials designed to prevent the spread of fire through the openings.

8) As well as any additional information required by individual sections of this Division

2. Shop Drawings

a. Submit for review scaled layout drawings showing the size/routing of all pathways and the size/information/locations of all boxes, pullboxes, firestopping systems, and access panels.

1) Each pathway shall be identified by type and size on the drawings.

a) Example #1: 4” EMT
b) Example #2: 4” x 12” Cable Tray

2) Each grounding conductor shall be identified by size (and insulation):

a) Example: #3/0 insulated ground

3) Each firestop system shall be identified by Manufacturer and Product, as well as UL system number for that particular location.

a) Example #1 – Firestopping Sleeve:
EZ-Path Series 22, UL System W-L-3255
b) Example #2 – Backbox in Fire-Rated Wall:
Specseal Power Shield, UL System QCSN/CLIV.R14288

4) Each pullbox and access panel shall be identified by size and height above finished floor.

a) Pullbox Example: Pullbox 8” x 24” x 40” approximately 12’ AFF.

b. Unless otherwise required by these specifications, it is permissible to show pathways systems (conduit, cable tray, auxiliary supports, etc.) on the same shop drawing along with the cabling and system work to be installed through those pathways.

D. Project Completion Submittal

1. Record Drawings:

a. The Quality Control Specialist shall review the installation and Record Drawings for the Common Work Results required for their scope of work and shall stamp the final Record Drawings with their RCDD or CTS-I stamp before submission. By stamping the Record Drawings, the Quality Control Specialist indicates that the Common Work Results have been installed per the Contract Documents and all associated codes, standards, and guidelines, and all changes to the drawings have been incorporated into the Record Drawings.

1.7 QUALITY ASSURANCE

A. Submittals and Shop Drawings for all Common Work Results specified in this section shall, if not created by, be reviewed by the Quality Control Specialist.

1. The Quality Control Specialist shall stamp all relevant submittals for their associated Division 27 sections, which indicates that at a minimum the proposed work has been reviewed by them and found to be in compliance in regards to:

a. All applicable codes and industry standards and guidelines referenced in Division 27.
b. Being fully-coordinated with all other trades and to be installed per the Construction Documents.
c. And installed per manufacturer's direction.

B. The Quality Control Specialist shall also make weekly inspections during construction to ensure all work installed per this section is correct.

1. Any deficiencies encountered prior to and during installation shall be corrected by the installing contractor under the direction of the Quality Control Specialist and/or the Design Consultant.

C. Firestopping Systems

1. Firestopping material and systems shall be tested and listed by UL. All firestopping products shall bear this classification marking.
2. Installation technicians shall be by qualified and trained personnel. Acceptable installer qualifications are as follows:

a. FM Research, approved in accordance with FM AS 4991.
b. Individuals who are trained and certified by the firestopping manufacturer. For Specified Technologies, all installers shall have current FIT Level 1 certification.

PART 2 - PARTS AND MATERIALS

2.1 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. General

1. All non-continuous cable supports shall be designed to prevent degradation of cable performance and pinch points that could damage cable
2. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
3. Telecommunications pathways shall be routed back to serving Communications Room. Refer to Drawings for additional information.

B. Cable Supports

1. The following manufacturers are Conditionally Approved.

a. Cooper/B-Line
b. Hilti
c. Monosystems
d. nVent Caddy
e. Panduit

f. Snake Tray
g. Or Approved Substitution (submitted and accepted in the “pre-bid” phase)

2. Metal Hook Supports (“J-hooks”)

a. Specifications

1) Have a flat bottom and sufficient width to comply with the minimum bend radius of all cabling as required by the referenced standards and manufacturers recommendations.
2) Be open for easy lay-in and removal of cabling
3) Be designed so the mounting hardware is recessed to prevent cable damage
4) Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3
5) Cable hooks for corrosive areas shall be stainless steel, AISI Type 304
6) Be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions
7) Be factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed

b. Cable hooks for installation above ceilings shall be

1) B-Line series BCH21, BCH32, BCH64
2) Caddy CABLE-CAT 21 or 32 series hangers
3) Or equivalent from Conditionally Approved manufacturer

C. Conduit

1. Specifications

a. Refer to Electrical Division 26 for specific product and material information.

1) Sizes, methods, and more stringent requirements shall be adhered to when specified in this Division.

b. Conduits provided as connection to incoming services, utilities, including private services to other buildings or outside connection points shall be rigid metal or intermediate metal conduit at the point it enters the building, emerges from an exterior wall or ground floor slab to the final termination/transition point.
c. If services enter a room or space such as a mechanical room, electrical room or other intermediate room due to convenience or proximity to the exterior and adequate space has not been provided within 50 feet (15.3 m) for the equipment needed for transitioning these and future cables/services to an appropriately rated indoor cable then those conduits shall be continued uninterrupted (except for necessary pull boxes) to the final

connection point or location where the transition point has been designated. Generally this connection point will be a designated Entrance Room for Communications or the Main Telecommunication space. If space has not been identified the contractor shall request information prior to bid.

d. Follow Electrical Division 26 for conduits underground, in slab or anywhere not within the building.
e. Provide conduit as indicated on the Drawings or required by this Specification. Minimum conduit size shall be 1 inch (25.4 mm) for structured cabling. Provide a polypropylene or monofilament plastic line with not less than 200-lb (90.7 kg) tensile strength in each empty conduit. Permanently mark or tag each conduit or pull box, identifying it as communications (Telecom), AV, TV, Broadcast, Intercom, etc.), at intervals of not more than 75 feet (22.9 m). Each conduit that is stubbed into the ceiling space from an outlet box shall be permanently marked or tagged; refer to Labeling requirements in Section 3 – Execution.
f. Route an empty conduit from each outlet box into the ceiling space above and terminate with a nylon bushing. In rooms with a non-accessible ceiling, route conduits to the nearest accessible corridor ceiling or communications space.

Number of Structured Cabling Outlets/Connectors	Conduit Size
Up to 4	1 inch (25.4 mm)
Up to 9	1-1/4 inch (31.8 mm)

D. Acoustical Pathway

1. Specifications

a. For use in non-rated walls only.
b. For use in place of conduit sleeves through walls of noise critical spaces.
c. Plenum Rated (to UL2043)
d. Sound Transmission Classification (STC) as tested per ASTM E90 shall be greater than 60.

2. Manufacturer shall be:

a. Hilti CS-SL SA
b. Specified Technologies, Inc. - NEZ33

E. Outlet Boxes

1. Specifications

a. Boxes shall either be square or rectangular, as noted on the drawings. Dimensions indicate minimum size.
b. Telecommunications – for outlets shown onT or TN series drawings:

1) For stud walls: dual-gang outlet box shall be a minimum size of 4-11/16 inches (119.1 mm) width by 4-11/16 inches (119.1 mm) height by 2-1/8 inches (54 mm) depth, with a dual-gang or single-gang raised cover/extension ring (as indicated on the drawings) a minimum of 3/8" deep. Depth shall match that of wall gypsum board(s).

    a) Double gang – RACO 258/259 (Coordinate knock-out size with conduit size indicated on drawings); or
    b) RANDL T-55017; or
    c) Or equivalent from

        i) Emerson/Appleton
        ii) Thomas & Betts/Steel City
        iii) Approved Substitution

2) For ceilings (flush or above accessible ceiling): *plenum-rated*, dual-gang outlet box shall be a minimum size of 4 inches (101.6 mm) width by 4 inches (101.6 mm) height by 2-1/8 inches (54 mm) depth, with a dual-gang or single-gang raised cover/extension ring (as indicated on the drawings) a minimum of 3/8" deep. Depth shall match thickness of gypsum ceiling board(s) or accessible ceiling panel (if applicable).

    a) Double gang – RACO 239 or equivalent, with ceiling grid framing where installed in accessible ceiling.
    b) Or equivalent from

        i) Emerson/Appleton
        ii) Thomas & Betts/Steel City
        iii) Approved Substitution

3) For 6" or 8" deep masonry walls: where single-gang faceplates are shown on the drawings, provide single-gang backbox a minimum of 3-1/2 inches deep; where double-gang faceplates are shown on the drawings, provide double-gang backbox a minimum of 3-1/2 inches deep.

    a) Single gang – RACO 695
    b) Double gang – RACO 696

4) Weatherproof: Aluminum die cast, weatherproof box with 1" conduit connection. Where single-gang faceplates are shown on the drawings, provide single-gang backbox a minimum of 2-1/2 inches ddep; where double-gang faceplates are shown on the drawings, provide double-gang backbox a minimum of 2-1/2 inches deep.

    a) Single gang – Thomas and Betts – IHD3-3 or equivalent

        i) Or equivalent from

(1) Emerson/Appleton
(2) Hubbell/RACO
(3) Approved Substitution

b) Double gang – Thomas and Betts – 2IHD5-3 or equivalent

i) Or equivalent from

(1) Emerson/Appleton
(2) Hubbell/RACO
(3) Approved Substitution

F. Pull Boxes – for interior use only

1. Specifications

a. NEMA 1
b. Refer to Execution section for sizing requirements.

2. The following manufacturers are Conditionally Approved.

a.
b. NEMA Enclosures
c. Wiegmann
d. Or Equivalent

2.2 FIRESTOPPING SYSTEMS

A. General

1. All firestopping systems for Division 27 conduit, sleeves, cabling, boxes, etc. shall be from a single manufacturer, unless otherwise noted.
2. The following manufacturers are Conditionally Approved.

    a. Hilti
    b. Specified Technologies, Inc

3. Communications ladder rack and cable tray shall not continue through a fire-rated wall. Stop the tray, install multiple fire-rated pathway devices, and continue tray on the other side. Ensure grounding of the tray is continuous through the wall.

B. Fire-Rated Pathway Device – for sleeves through a single penetration (wall or floor)

1. Specifications

    a. Minimum performance requirements: Shall meet testing requirements of ASTM E-814 or U.L. 1479; Shall be installed in accordance with the NRTL. Provide fire stop systems appropriate for the specific application and in accordance with manufacturer's instructions.
    b. Shall meet or exceed the ratings of the wall or floor that it penetrates.
    c. Shall be a pre-fabricated and zero-maintenance solution which requires no action to activate the fire and smoke protective characteristics of the device.
    d. Allows the installation and removal of cables without the need to remove or add any materials.
    e. Used to seal penetrations of cables through fire rated partitions
    f. Not subject to the single manufacturer requirement

2. Manufacturer shall be:

    a. EZ-Path family of products by Specified Technologies Inc.
    b. Hilti Firestop Speed Sleeve CP 653 Series

C. Firestopping for Backboxes in Fire-Rated Walls

1. Specifications

    a. Used to seal backboxes in fire rated partitions.
    b. Minimum performance requirements: Shall meet UL testing requirements of UL 263 and classified as Wall Opening Protective Material (QCSN or CLIV); Shall be installed in accordance with the NRTL. Shall meet or exceed the ratings of the wall or floor that it is located in.
    c. Provide fire stop systems appropriate for the specific application and in accordance with manufacturer's instructions.

2. Manufacturer shall be:

a. Hilti CP 617 or CFS-P PA
b. Specified Technologies Inc., SpecSeal Power Shield
c. Or equivalent from Conditionally Approved manufacturer.

D. Firestopping for Thru-Wall (or Floor) Conduit Penetrations and Other Applications

1. For fire-rated penetrations where the conduit pathway extends beyond a single fire-rated partition/floor, and other required firestopping applications not previously addressed in this specification.
2. Specifications:

a. Shall be UL listed for the specific application; Shall meet or exceed the ratings of the wall or floor that it penetrates.

3. Manufacturer shall be:

a. Hilti – submit UL System documention for each floor/wall type and product cutsheets for all Hilti materials to be utilized
b. Specified Technologies Inc. – submit UL System documentation for each floor/wall type and product cutsheets for all STI materials to be utilized
c. Or equivalent from Conditionally Approved manufacturer.

2.3 ACCESS PANELS

A. Access Panels

1. Where pullboxes are required above inaccessible ceiling spaces, or for other required conditions, provide an appropriately-sized access panel. The following manufacturers are Conditionally Approved.

a. Activar/J.L Industries
b. Acudor Products
c. Alfab/Barco
d. Elmdor Products
e. Karp Associates, Inc.
f. Milcor
g. Nystrom Building Products
h. Williams Brothers
i. Wind-lock
j. Or Approved Substitution (submitted and accepted in the “pre-bid” phase)

2. Specifications:

a. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation.
b. Joints and seams: continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

c. Frames: 16-gauge steel, with a 1 inch (25.4 mm) wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling:

1) For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
2) For gypsum wallboard or plaster: perforated flanges with wallboard bead.
3) For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

d. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
e. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

3. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.
4. Indicate proposed size and locations on pre-construction shop drawings. No access panels shall be installed without Architect and Design Consultant approval.

2.4 IDENTIFICATION FOR COMMON WORK FOR COMMUNICATIONS SYSTEMS

A. Labels

1. The following manufacturers are Conditionally Approved for generic labeling requirements for conduits, pullboxes, and equipment racks.

a. Brady
b. Brother
c. Dymo
d. HellermannTyton
e. Panduit
f. Or Approved Substitution (submitted and accepted in the “pre-bid” phase)

2. Specifications:

a. Refer to additional requirements in Part 3 – Execution.
b. Refer to individual sections for additional identification requirements for specific work.

2.5 KEYS

A. Supply two copies of every key as required for pullboxes, junction boxes, and access panels.

PART 3 - EXECUTION

3.1 PATHWAYS FOR COMMUNICATIONS

A. General

1. Refer to Electrical Division 26 for additional installation requirements.

    a. Where a conflict exists between Division 26 and Division 27 the more stringent requirements shall apply.

2. All supports shall be specifically designed to support the required cable weight and volume. Field manufactured supports will not be accepted.
3. Install a pull cord in each pathway (empty or not) for installation of new wires or cables. Use polypropylene or monofilament plastic line with not less than 200 lb (90.7 kg) tensile strength. Leave at least 12 inches (304.8 mm) of slack at each end of pull cord.
4. Unless otherwise noted, pathway routing shown on the Drawings is illustrative only and meant to indicate the general configuration of the work. Install pathways so that adequate clearances and offsets between pathways and other trades are provided. Coordinate all pathways with other trades prior to installation.
5. All pathways shall include empty space for a minimum of 25% growth beyond initial installation of cabling when contractor performs conduit sizing calculations, otherwise follow conduit sizes indicated on drawings.
6. Cables shall be rigidly supported by cable pathways as indicated on the drawings. Cables shall be physically supported at intervals not to exceed 5 feet (1.52 m).
7. Store and keep dry all products in original container in a climate controlled environment until installation is to occur
8. Install all communications pathways:

    a. So that cables are allowed to be pulled in accordance with referenced standards and guidelines.
    b. So that cables are allowed to be pulled without damage to conductors, shield, armor, or jacket.
    c. So that cables are not forced or allowed to exceed minimum allowed bend radius by manufacturer or referenced standards and guidelines.
    d. So that the maximum allowable pulling tension is not exceeded.
    e. To meet the requirements of the structure and the requirements of all other Work on the Project
    f. To clear all openings, depressions, ducts, pipes, reinforcing steel, and so on.

g. Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Architect.
h. Parallel or perpendicular to building lines or column lines.
i. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

9. Cables shall remain unattached to pathways or other cables and shall simply lay at rest on the supports provided by its pathway (including cable trays, wire basket, j-hooks, conduit, etc.). Wire ties, velcro straps, electrical tape or other methods shall not be used to attach cables to cable supports; UON.

    a. Except when supported by ladder racking within each Telecommunications room, UON.

10. Provide adequate communications pathways so that cabling is not forced to attach, be supported, or use other pathways not specifically designed and provided for communications cabling purposes. Any deviation from this will not be accepted.

    a. At no point shall cables come in contact with, be supported by, or attach to other trades equipment or supports. UON
    b. At no point shall cables come in contact with, be supported by, or attach to building structures or supports; UON

11. Provide appropriately sized sleeves where cables are required to pass through non-rated full-height partitions. Where allowed, sleeves shall extend a minimum of 3 inches (76.2 mm) beyond the partition surface on both sides, and shall be rigidly supported to support the weight of cables. Sleeves shall be sized so that no more than 50% of the cross-sectional area is utilized by the cabling to be installed. The minimum inside diameter of each sleeve shall be nominal 2 inches (50.8 mm).
12. Suspended cables shall be installed with at least 3 inches (76.2 mm) of clear vertical space above the ceiling tiles and support channels (T-bars).
13. Waterproofing

    a. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
    b. Restore waterproofing integrity of walls or surfaces after they have been penetrated without additional cost to the Owner.

14. Cutting and Patching

a. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, layout the work carefully in advance. Repair any damage to the building, piping, equipment or defaced finished plaster, woodwork, metalwork, etc. using skilled tradespeople of the trades required at no additional cost to the Owner.
b. Do not cut, channel, chase or drill masonry, tile, etc., unless permission from the Architect is obtained. If permission is granted, perform this work in a manner acceptable to the Architect.
c. Patch around all openings to match adjacent construction.
d. Where conduit or equipment is mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.
e. Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.
f. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

15. Mounting Heights

a. Mounting heights for equipment and devices requiring operational acess shall conform to ADA requirements.

1) Wall mounted devices requiring operational access shall be mounted a minimum of 15 inches above finished floor to bottom of device and a maximum of 48 inches above finished floor to top of device.

b. Mounting heights shall be from floor to center of device, unless otherwise noted. Verify exact locations and mounting heights with the Architect before installation.
c. Typical mounting heights shall match nearest adjacent typical electrical outlet mounting height UON or as directed by the Architect.

16. Painting

a. Refer to Division 9 Section “Painting” for painting requirements.
b. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.
c. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer’s instructions for pre-cleaning surfaces and application.
d. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.

e. Where factory finishes are provided and no additional field painting is specified, touch-up or refinish, as required by, and to the acceptance of, the Architect and Design Consultant, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Architect or Design Consultant, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.
f. Provide touch-up paint as required by Specification Sections in this Division.

17. Fastenings

a. Fasten equipment to building structure in accordance with the best industry practice.
b. Where weight applied to the attachment points is 100 pounds or less, conform to the following as a minimum:

1) Wood: Wood screws.
2) Concrete and solid masonry: Bolts and expansion shields.
3) Hollow construction: Toggle bolts.
4) Solid metal: Machine screws in tapped holes or with welded studs.
5) Steel decking or sub-floor: Fastenings as specified below for applied weights in excess of 100 pounds.

c. Where weight applied to building attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following as a minimum:

1) At concrete slabs provide 24 inch x 24 inch x ½ inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top of slab screed line, where no fill is to be applied.
2) At steel decking or sub-floor for all fastenings, provide through bolts or threaded rods. The tops of bolts or rods shall be set at least one inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with his decking or sub-floor such hangers shall be provided.

d. Where weight applied to building attachment points exceeds 300 pounds, coordinate with and obtain the approval of Architect and conform to the following as a minimum:

1) Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.

e. For items, which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible,

provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.

f. Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars. Prefabricated steel channels as manufactured by Kindorf or Unistrut are acceptable.

g. Bridle rings are prohibited for Division 27 cables, unless otherwise noted on drawings.

18. Areas identified as noise critical spaces shall have all penetrations sealed to minimize sound transmission between adjacent spaces. Install Acoustical Pathway(s) through walls of noise critical spaces

B. Access to pathways and associated equipment

1. Locate all cable trays, open hanger cable supports, j-hooks, pull boxes, junction boxes and fire stopping systems so as to provide easy access for operation, service inspection and maintenance.
2. Provide an Access Panel where equipment or devices are located above inaccessible ceilings. Where access doors are necessary but not shown on the plans, coordination type and location with Architect and Design Consultant through an RFI.

a. Pathways requiring access such as open hanger cable supports, j-hooks, and cable trays shall have an access door or other means of direct access at a minimum of 10 feet (3 m) intervals.

b. Cables or cable pathways requiring access such as open hanger cable supports, j-hooks, and cable trays may not change directions above an inaccessible ceiling unless complete access to the change of direction in pathway or cable route is within arms reach 3 feet (0.9 m) from adjacent accessible point.

3. Maintain all code required clearances and clearances required by manufacturers.

C. Cable distribution

1. Provide pathways for Telecommunications (Structured Cabling System) to allow cabling to be installed in the following manner:

a. For typical new walls:

1) Conduit from outlet location to accessible ceiling then j-hooks to main run of cable tray.

b. For phone and data lines to all Elevator Equipment Rooms and Fire Alarm panels:

1) Homerun method: Conduit from outlet location all the way back to the Telecommunications Room/Space.

c. See drawings for clarification

D. Conduits

1. Conduit shall be of the appropriate type required by code and as required by Electrical Division 26.
2. Adequate access shall be available where cables enter conduits
3. Bond and ground all metallic conduits and boxes in accordance with national or local requirements and with TIA-607B – "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
4. Install conduits in the most direct route possible, running parallel to building lines
5. Ream all conduit ends and fit them with an insulated bushing to eliminate sharp edges that can damage cables during installation or service.
6. Conduits which enter Telecommunications rooms shall extend 3 inches (76.2 mm) AFF or through the wall.
7. Conduits which enter Entrance Facilities shall extend 4 inches (101.6 mm) AFF or below the finished ceiling (if exists).
8. Flexible conduits may only be used where specifically allowed by these contract documents.

    a. Flexible conduit sections shall be less than 20 feet (6.1 m) in length.

9. No continuous section of a conduit may exceed 100 feet (30.5 m) without a pullbox.
10. For structured cabling, no more than (2) 90° bends, or equivalent will be allowed between pullboxes.

    a. Each and any offset shall be considered a 90° bend.
    b. A pullbox is required wherever a reverse bend is installed.

11. The minimum bend radius for conduits is

    a. (6) times the inside diameter for 2 inches (50.8 mm) conduits or less.
    b. (10) times the inside diameter for conduits greater than 2 inches (50.8 mm).

12. Any single conduit run may not serve more than (1) outlet location unless expressly indicated on the drawings.
13. Conduits shall contain no electrical condulets (also known as LBs).

    a. Exception: Pre-approved (by the Design Consultant) condulets specifically manufactured for communications cabling and will maintain minimum bend radius for cabling to be installed. These locations are to be called out on the shop drawings.

14. Underground Conduit Requirements

    a. For Structured Cabling System horizontal cabling and pathways within the footprint of the building and serving voice and data outlets exterior to the

building, such as emergency phones/towers, security cameras and wireless access points attached to exterior light poles, etc.

b. Requirements

1) Refer to applicable details on drawings for illustrative requirements.
2) Wherever practical, slab-on-grade floorboxes shall have conduit extended underground or in-slab from box to serving communications room or equipment cabinet.

a) Only one horizontal bend is allowed, 90 degrees or less.
b) Indicate proposed routing and stub-up locations on shop drawings.

3) Route all underground conduit so there is no more than (3) 90 degree bends, including stub-up bend at communications room/equipment cabinet.

a) For underground conduit serving outlets/boxes outside the footprint of the building that require more than (3) 90 degree bends, provide appropriately-sized handhole(s). Coordinate location with Architect and Owner, indicate proposed location(s) on shop drawings, and include product information in pre-construction submittals. In general, handholes are not to be located in roadways, parking lots, sidewalks, or any location that may be subject to vehicular traffic.

4) Approved conduit types:

a) When routed in slab-on-grade:

i) Horizontal conduit shall be RMC or Schedule 40 PVC, including horizontal bends. If PVC is installed, also install tracer wire.
ii) Vertical bends shall be RMC.

b) When routed below slab-on-grade or outside the fooprint of the building:

i) Horizontal conduit shall be RMC or Schedule 40 PVC a minimum of 12” below grade. If PVC is installed, also install tracer wire.
ii) All vertical and horizontal bends shall be RMC.

15. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints.
16. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Architect, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Architect, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.

E. Outlet boxes

1. No outlet boxes shall be located back-to-back in a wall cavity.

    a. Where possible offset to next stud cavity, with a minimum of 6 inch (152.4 mm) separation.

2. Outlet boxes shall be within 3 feet (0.9 m) of nearest electrical outlet.
3. Outlet boxes located in fire-rated walls are to have the appropriate firestopping for backboxes. These locations are to be identified on shop drawings.
4. Where cabling enters a backbox directly (not via conduit), provide black rubber grommet on knockout.

F. Pull Boxes

1. Pullboxes shall be placed in Conveniently Accessible locations.
2. Coordinate the location and installation of all pullboxes to ensure adequate access is provided.
3. Pullboxes above an accessible ceiling shall:

    a. Be aligned directly over the ceiling grid to allow access
    b. Be installed with a minimum of 3 inches (76.2 mm) clearance to ceiling grid and tiles

4. No directional changes shall be allowed in pullboxes. Conduit Shall continue in the same direction as it enters and then change direction via an appropriately sized bend in the conduit.
5. Size pullboxes according to the following chart (all sizes are minimums):

Conduit Trade Size	Width	Length	Depth	Width Increase for Additional Conduit (of same size)
¾" or smaller	4"	4"	2-1/8"	Not applicable
1"	4"	16"	3"	2"
1-1/4"	6"	20"	3"	3"
1-1/2"	8"	28"	4"	4"
2"	8"	36"	4"	5"
2-1/2"	10"	42"	5"	6"
3"	12"	48"	5"	6"
4"	16"	60"	8"	6"

3.2 LABELING

A. Labeling Installation

1. Labels that are to be secured by adhesive. They shall have a type of adhesive that is appropriate for the particular surface upon which the label is to be installed. The mounting surface shall be free of dust, dirt, oil, etc. that would impede the adhesion of the labels.

B. Labeling Requirements

1. Labels are to be installed on:

a. All firestopping systems. For wall and floor penetrations, label on both sides. See Firestopping later in this section.
b. All pathways (e.g., conduit, innerduct, etc.) installed under this work.

1) Label all conduit and innerduct with “TELECOM” or “AV” according to the intended system/use of the installed (or future) cabling. Conduit labels shall utilize text readable from a standing position on the finished floor. Conduit sleeves which pass through a single wall or floor need not be labeled.

a) For wall stub-up locations, label overhead only.
b) For conduits greater than 10’, label both ends of conduit with far end location and Room/Number.

i) Example – “AV to AV Rack R01”.

c) For conduits that stub directly up or into a Communications Room, label both ends of conduit.

i) Example: underslab conduit from Telecom Room 1A to the Floor Box in Confence Room 101A shall be labeled as follows:

(1) Conduit stub-up location in Telecom Room 1A – “Telecom to Conf. Rm 101A Floorbox”
(2) Bottom of floorbox, immediately adjacent to serving Telecom conduit – “Telecom to Telecom Room 1A”

2) All pullboxes and junction boxes for Communications shall be labeled such as “TELECOM PULLBOX”, “AV JUNCTION BOX”, “TV”, etc. on the cover, such that the text is of sufficient size to be readable from a standing position on the finished floor.

a) Conduits entering and exiting all pullboxes and junction boxes shall be labeled with their destination/room number – ie “To AV Box Q:212:01 in Control Rm 212”.

c. In general, the label is to be provided and installed by whomever installed the item that is being labeled.
d. Refer to individual Division 27 Communications sections and to the drawings for additional information on labeling requirements.

3.3 FIRESTOPPING

A. General

1. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall, floor or ceiling penetrations; including membrane penetrations. All materials shall be classified or listed as a complete system by UL (or an approved NRTL by the Design Consultant and AHJ) and meet NEC and local codes. The use of partial systems or components of systems is not allowed unless specifically identified in the documents.
2. All penetrations through fire rated floors and walls shall be sealed to prevent the passage of smoke, flame, toxic gas or water through the penetration before, during or after a fire. The fire rating (F and T) of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by referenced building codes.

    a. Assume all floors are fire-rated, unless otherwise noted.
    b. Also install fire stops at any other locations indicated in the Specifications or Drawings.

3. Provide a label on both sides of fire rated assembly at all fire stop locations indicating:

    a. Fire stop Manufacturer
    b. Installer and company
    c. Date installed
    d. UL system number with all relevant ratings indicated

4. Include labels in each telecom room in which one or more fire rated walls is installed. Provide a 2” block letter stencil label on the inside of the telecom room to indicate rating for each barrier.
5. Provide systems as identified on the drawings and specified herein. At locations where the cabling routing encounters a fire-rated barrier provide an adequately sized fire stop device for the quantities and types for all cables to be installed plus 25% growth.

B. Penetration Sealant – Conduits

1. Provide listed system to seal around openings between wall, floor or partition around conduits in accordance with system listing and manufacturer’s instructions.

C. Penetration Sealant – Voids, Cavities, and Openings

1. Install fire stop materials in the framed openings through fire rated partitions per the Architect's drawings and in accordance with the NRTL listed system instructions.
2. Fire stop all voids, cavities, and openings left by the removal of cabling, conduits, conduit sleeves, cable trays or other equipment related to the communications systems not to be reused.

3. Install the fire stop system in accordance with the manufacturer's instructions and local codes.

D. Fire-Rated Pathway Device

1. Provide fire-rated pathway device anywhere cables are required to pass through fire-rated walls, floors or partitions.
2. Devices shall be installed in locations where required by the Contract Drawings, arranged individually or appropriately ganged.
3. Install the devices in strict accordance with the approved shop drawings and the equipment manufacturer’s recommendations.
4. Apply the factory supplied gasketing material (where required) prior to the installation of the wall plates.
5. Secure wall plates (where required) to devices per the equipment manufacturer’s recommendations.

END OF SECTION 270500

SECTION 271000 - STRUCTURED CABLING SYSTEM

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Provide a complete functioning telecommunications structured cabling system, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.

B. Specification sections 271000 through 271999, and Drawings numbered with prefixes T[N], generally describe these systems, but the scope of the Structured Cabling System Work includes all such Work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing, Electrical, Communications, and Electronic Safety and Security Drawings and Specifications; and Addenda.

C. This section includes additional requirements for the Structured Cabling (Telecommunications) System, which include the following:

1. Quality Assurance requirements, including Contractor qualifications and advanced warranties

1.2 RELATED DOCUMENTS

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

B. Division 27 Section “General Communications”.

C. Division 27 Section “Common Work Results for Communications”.

D. Requirements of this Section apply to all Sections 271000 through 271999.

1.3 STANDARDS

A. The references to the following standards represent the most current and up-to-date revisions or printing as of the issue of this document including all sections, parts and their addenda. The Contractor is responsible for following the correct revision or printing (UON):

1. ANSI/TIA-568 – “Commercial Building Telecommunications Cabling Standard Set”
2. ANSI/TIA-569 – “Commercial Building Standard for Telecommunications Pathways and Spaces”
3. TIA-526 – “Standard Test Procedures for Fiber Optic Systems”
4. TIA TSB 140 – “Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems”
5. ANSI/TIA-606 – “Administration Standard for Commercial Telecommunications Infrastructure
6. ANSI/TIA-607 – “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”
7. ANSI/BICSI/NECA 568 – “Standard for Installing Commercial Building Telecommunications Cabling”

1.4 GUIDELINES

A. The references to the following guidelines represent the most current and up-to-date revisions or printing as of the issue of this document including all sections, parts and their addenda. The Contractor is responsible for following the correct revision or printing (UON)

1. BICSI Information Technology Systems Installation Methods Manual (ITSIMM)
2. BICSI Telecommunications Distribution Methods Manual (TDMM)

1.5 DEFINITIONS

A. Structured Cabling System – the physical infrastructure installed to support information technology/transport for voice and data applications, commonly referred to as a Telecommunications System. This includes, but is not limited to: Category 3/5e/6/6A copper cabling, terminations/blocks, modules, faceplates, etc., and optical fiber cabling, terminations, modules, etc.

B. Wet Location - as defined in the NEC, installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

1.6 QUALITY ASSURANCE

A. Personnel Qualifications:

1. Provide and maintain a BICSI Registered RCDD in good standing on staff as a full-time employee at all times. This RCDD shall be familiar with the project and available to attend all scheduled project meetings when required by the Owner/Design Consultant.

2. Provide and maintain a Project Manager whom is a BICSI Registered Certified Technician Level 2 Installer in good standing on site at all times. This project manager shall attend all scheduled project meetings and be responsible for all Submittals.
3. The person(s) conducting the testing for all Telecommunications cabling shall be a current BICSI Certified Level II Commercial Installer or higher.
4. Any additional personnel that will be physically installing any part of the Telecommunications Infrastructure covered by this Division shall, at a minimum, be a BICSI Certified Level 1 Commercial Installer in good standing or have equivalent manufacturer training certificate (of those identified as approved for this project) and approved by the Design Consultant.
5. These requirements are provided as a minimum level of qualification. Any additional or more stringent requirements by the specific manufacturer chosen to provide the proper level or term of warranty as specified in this division shall be met.
6. Alternate qualifications may be considered if requested alternates are provided in accordance with the substitution section herein prior to bid.

B. Contractor qualifications:

1. Provide a list of projects (no less than 2) of similar size, scope and type in which the Bidder has performed in a capacity comparable to the size, scope and type outlined in these Construction Documents. Provide the project name, relevant project information for comparison evaluation, and contact names with telephone numbers of each such project.

1.7 ADVANCED STRUCTURED CABLING SYSTEM WARRANTY

A. All components, including but not limited to, connectors, terminal blocks, cabling and all other components considered to be a part of what is commonly referred to as an end-to-end solution for all backbone and horizontal cabling systems, shall be warranted for a minimum period of 15 years from the date of installation against defects in materials, equipment and workmanship. This warranty shall also include the performance of these systems. This warranty shall include transmission requirements as specified in applicable ANSI/TIA/IEC/ISO standards for each cable system specified. This warranty shall also include all current and future applications designed for and becomes available under warranty for each cable system.

1. Warranty shall be guaranteed by a single reputable manufacturer such as:

a. Belden Incorporated
b. CommScope Inc.
c. Legrand/Ortronics
d. Leviton
e. Panduit
f. Siemon
g. Or Approved Substitution (submitted and accepted in the “pre-bid” phase)

B. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.

C. Perform the remedial work promptly, upon written notice from the Architect or Owner.

D. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.8 WORK INCLUDED

A. Provide labor, materials, and accessories required to provide complete, operating Telecommunications Infrastructure systems as called for in the Contract Documents and in accordance with applicable codes and regulations. Labor, materials or accessories not specifically called for in the Contract Documents, but required to provide complete, operating infrastructure systems shall be provided without additional cost to the Owner. The work includes, but is not necessarily limited to, the following:

1. All horizontal cabling between the Telecommunications rooms and the outlets.
2. All backbone cabling, including cabling between the Telecommunications Entrance Facility Room and the Telecommunications rooms and designated Telecommunications equipment rooms.
3. All termination blocks, outlets/jacks, patch panels, patch cords, cabinets, equipment racks, etc., required to support, terminate and/or cross connect cabling at the main cross-connect, Telecommunication rooms and/or other designated equipment locations.
4. All physical cable management hardware including, but not limited to: “J-hooks” in accessible ceiling areas, cable trays, conduits, ladder-type cable racks within telecommunication rooms and “D-rings” on backboards and equipment racks/cabinets/frames.
5. A Grounding/Bonding System, as described in these construction documents.
6. Termination, cross connect and patching of all cable pairs as indicated herein or on schedules or on drawings.
7. Testing, labeling and documentation of all cables and hardware installed under this contract.
8. Preparation and submission of shop drawings, testing reports, as-built drawings, and cabling documentation as described below.

1.9 COORDINATION

A. The locations of cable termination fields, outlets, patch panels, equipment racks and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions, or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

B. Exercise particular caution with reference to the location of outlets, patch panels, control panels, switches, etc., and have precise and definite locations accepted by the Architect before proceeding with the installation.

C. The Drawings show only the general run of raceways and approximate locations of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Architect for review before such alterations are made. Modifications shall be made at no additional cost to the Owner.

D. Verify with the Architect the exact location and mounting height of outlets and equipment not dimensionally located on the Drawings.

E. Outlet/cable tags in the form of alpha/numeric characters are used where shown to indicate the outlet and cable designation numbers in cable termination fields (terminal blocks and/or patch panels. Show the actual outlet/cable numbers on the as-built drawings, on the associated typed termination field labels and in the printed and computer readable cabling schedules. Where sample outlet/cable-numbering information is not indicated, request clarification from the Architect.

F. The drawings generally do not indicate the number of cables in conduit, or the actual identity of cables in specific conduits, cable tray or other cabling pathways. Provide the correct cable type and quantity as required by the indicated outlets, cable schedules, the design intent of any example drawings or schedules, referenced wiring diagrams (if any), the maximum distance limitations, and the applicable requirements of the NEC and ANSI/TIA-568.

G. Adjust location of conduits, terminal blocks, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication.

1. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.

1.10 SUBMITTALS

A. Refer to requirements in Division 27 Section “General Communications Requirements”. At a minimum, include the following items:

1. “Pre-bid” Phase

a. Product substitutions, approved alternate or equivalent requests to be reviewed for approval (Prior to Bid)
b. Alternate personnel credentials to be reviewed for approval

2. “Bid” Phase

    a. Bid Response Forms
    b. Personnel Qualifications / Credentials - Supplemental to Division 1 requirements submit the following documents to indicate the required personnel qualifications per the quality assurance section of this section:

        1) Member of staff required to be RCDD

            a) A copy of their valid RCDD certificate, RCDD number, and BICSI member number shall be provided with bidding documents.

        2) On-site project manager

            a) A copy of their valid BICSI Certified Technician certificate and BICSI member number shall be provided with bidding documents.

        3) Other personnel physically installing any portion of the Communications infrastructure

            a) A copy of their valid BICSI Commercial Installer certificate and BICSI member number shall be provided with bidding documents
            b) An alternate certification may be considered by the Design Consultant for approval, which shall be completely at the Design Consultant’s discretion.
            c) If the contractor chooses to submit an alternate certification from one of the conditionally approved vendor list as an acceptable alternate for a BICSI Commercial Installer, the following shall be included:

                i) A valid copy of each certification with the person’s name and member number including the manufacturer’s logo
                ii) A document provided by the manufacturer describing what specific subjects the certification covers, period of time spent doing course work required to gain certification, exam topics, and the requirements needed to maintain the certification.

        4) Contractor Qualifications (Previous project references)
        5) Voluntary Bid Alternates

3. “Pre-construction” Phase

    a. Warranty information

1) Sample warranty certificate for the Advanced System Warranty, indicating manufacturer and terms/conditions
2) Proof that Contractor is certified with the Advanced System Warranty manufacturer

b. Resubmit Contractor and Personnel Qualification, update if necessary
c. A typed list, indexed by Specification section, of products specifically identified by part number (no wild card characters) within each specification section in this Division. Order shall match that as in these specifications.
d. Manufacturers' cut-sheets, in same order as typed list and in these specifications.

1) At a minimum all cut-sheets shall contain the following:

a) Cross-reference to the specification section and/or drawings for which the product is to be reviewed for compliance and acceptance
b) Every product cut-sheet submitted for review shall contain the manufacturers' name and logo
c) All parts, pieces, and equipment submitted for review shall be identified specifically by stamp, or highlighted in such a manner that the product(s) being considered are clearly identifiable and distinguished from all other materials, parts or equipment that may be on the submittal.
d) For cut-sheets with accessories, additional parts, or derivations of the product being submitted all shall be clearly identified for the reviewer and acceptance.
e) Sufficient detail for reviewer to identify all required information, such as size, weight, color, NRTL listings, approval or certification information, and other necessary identifying information to confirm product meets specifications.

e. Shop Drawings
f. And as required by individual sections in this Division

4. Phase four - "Project Completion"

a. Preliminary Project Completion submittal requirements:

1) To be submitted:

a) After all horizontal and backbone cabling has been installed, terminated, labeled, tested, and corrected so that all cables and strands pass the Testing Requirements.
b) In conjunction with the Substantial Completion Review request.

i) Design Consultant requires a minimum of 2 weeks notice to schedule the on-site Substantial Completion Review.

ii) Substantial Completion Review shall be a minimum of 4 weeks before Substantial Completion, or earlier if the Project Schedule requires it, to allow for major Punch List items to be address by Contractor.

2) Submittal shall include:

a) Scanned Work Site Prints that include horizontal and backbone cable/outlet labels that correspond to the Test Results.

b) Passing Test Results for all cables and strands, in the following formats:

i) Abbreviated Test Results in Excel or CVS file format, shown in numerical/alphabetical order, with the following information:

(1) Project Name
(2) Date of Preparation
(3) ID of Work Area Outlet / connector being tested
(4) Date of test
(5) Contractor's Name
(6) Media Type
(7) Make, Model, and Serial Number of test equipment used
(8) Date of last calibration
(9) Names of test crew
(10) Serving Telecommunications Room Number (all tests shall be submitted in numerical / alphabetical order by Telecommunications Room)
(11) Category or type of cable being tested
(12) Pass or Fail status

ii) Full Test Results in the original file format of the tester (example: .mdb file), shown in numerical/alphabetical order, with the following information:

(1) Project Name
(2) Date of Preparation
(3) ID of Work Area Outlet / connector being tested
(4) Date of test
(5) Contractor's Name
(6) Media Type
(7) Make, Model, and Serial Number of test equipment used
(8) Date of last calibration
(9) Names of test crew

(10) Serving Telecommunications Room Number (all tests shall be submitted in numerical / alphabetical order by Telecommunications Room)
(11) Category or type of cable being tested
(12) Full Test Result Data (per Part 3 of this specification)

b. Final Project Completion submittal requirements:

1) Advanced Structured Cabling System Warranty Certificate. Warranty terms and conditions shall contain the following:

a) Length of warranty period
b) Applications covered (future and present)
c) Single manufacturer responsible for fulfilling warranty
d) Who is covered
e) What is covered
f) All disclaimers, limitations, etc.
g) What, if anything, is not covered

2) Product Information

a) Product List (Bill of Materials) – a typed list of products (in order of these specifications), in Excel or CSV file format, indicating:

i) Product Type (as identified in these specifications)
ii) Manufacturer
iii) Model Number
iv) Quantity installed
v) Serial Number (if applicable)
vi) Manufacturer Warranty date (if longer than 1 year)

b) Manufacturer Cut Sheets / Specification Sheets
c) Operation and Maintenance Manuals – manufacturer's installation, service, and maintenance instructions.
d) Warranty certificates (for products not covered by the Advanced System Warranty)

i) If products require registration, register on the Owner's behalf.

3) As Built Drawings

a) At the completion of the project, incorporate changes to the Structured Cabling System noted on the jobsite work prints onto a set of as built Drawings. These changes shall be done electronically in AutoCAD and saved to PDF and AutoCAD 2013 dwg format.
b) Include date and installing contractor's logo and contact information in the title block.

c) Mark each sheet "As Built Drawing".
d) Drawings shall include:

i) Corrected items from Substantial Completion Review punch list.
ii) Cable ID (all characters) for each work area outlet jack (so that they are searchable in the PDF version)
iii) Routing of cable/conduit/cable tray and location of any firestopping systems and pull boxes.

4) Updated, complete Test Results in the following formats (to include the retesting data of any cables installed or modified after Preliminary Project Completion submittal):

a) Abbreviated Test Results in Excel or CVS file format, shown in numerical/alphabetical order, with the following information:

i) Project Name
ii) Date of Preparation
iii) ID of Work Area Outlet / connector being tested
iv) Date of test
v) Contractor's Name
vi) Media Type
vii) Make, Model, and Serial Number of test equipment used
viii) Date of last calibration
ix) Names of test crew
x) Serving Telecommunications Room Number (all tests shall be submitted in numerical / alphabetical order by Telecommunications Room)
xi) Category or type of cable being tested
xii) Pass or Fail status

b) Full Test Results in the original file format of the tester (example: .mdb file), shown in numerical/alphabetical order, with the following information:

i) Project Name
ii) Date of Preparation
iii) ID of Work Area Outlet / connector being tested
iv) Date of test
v) Contractor's Name
vi) Media Type
vii) Make, Model, and Serial Number of test equipment used
viii) Date of last calibration
ix) Names of test crew
x) Serving Telecommunications Room Number (all tests shall be submitted in numerical / alphabetical order by Telecommunications Room)

xi) Category or type of cable being tested
xii) Full Test Result Data (per Part 3 of this specification)

B. All submittals for Division 271000 through 271999 (Structured Cabling System) work at each phase shall be submitted together and in one package. “Piecemeal” submissions will not be reviewed. It is permissible to combine 270500 Common Work Results submittals with that of the Structured Cabling System.

C. For each room or area of the building containing Structured Cabling System infrastructure and equipment, submit the following as part of the shop-drawings and as-built drawings:

1. Floor plans, at not less than 1/8" scale, showing routing of Communications conduits, cable trays, and wireways, including surface-mounted raceways and pullboxes. Also show the routing of bundles of cables supported by "J-hooks", or similar means, if and where such installation practices are allowed by the Contract Documents.

    a. Outlet locations shall be identified with jack/module type and label. Coordinate labeling scheme with Owner prior to submitting.

2. Riser diagrams showing types, quantities and schematic routing of all Communications backbone pathways, cabling and the TBB and BCT.
3. Enlarged plan views and elevation layout drawings for the Telecommunications Entrance Facility Room, Telecommunications Rooms and all other designated Telecommunications Equipment Rooms indicating the equipment in the exact location in which it is intended to be installed. These plans shall be of a scale not less than ¼ inch = 1’-0”. They shall be prepared in the following manner:

    a. Indicate the physical boundaries of the space including door swings and ceiling heights and ceiling types (as applicable).
    b. Illustrate all Communications equipment proposed to be contained therein. The Drawings shall be prepared utilizing the dimensions contained in the individual equipment submittals. Indicate code and manufacturer’s required clearances.
    c. Illustrate all other equipment therein such as conduits, detectors, lighting fixtures, ducts, registers, pull boxes, wireways, structural elements, etc.
    d. Indicate the operating weight of each piece of equipment.
    e. Indicate dimensions to confirm compliance with code-required clearances.
    f. Indicate maximum normal allowable operating temperature for each piece of equipment (as per each respective manufacturer’s recommendation). (Note: This requirement applies to active Communications equipment such as LAN hubs, routers, amplifiers, radio transmitters/receivers, PBX or key telephone equipment, etc., if installed under this work.)
    g. Equipment removal routes for individual equipment items with plan dimensions exceeding 24" by 36" or height exceeding 84".

D. The Communications Equipment room layout submittals and the related Structured Cabling System submittals shall be submitted concurrently. Failure to submit concurrently may result in the immediate return of the submittal marked REVISE AND RESUBMIT.

PART 2 - PRODUCTS

2.1 110-STYLE PUNCHDOWN TOOL

A. Manufacturer shall be: Panduit PDT-110 or equivalent.

2.2 COPPER TESTING EQUIPMENT

A. Category 6 Cable Tester

1. Available Manufacturers. Contractor may submit other cable testers that meet specification requirements.

a. Category 6 Cable Tester

1) Fluke
2) Ideal
3) Softing
4) Viavi

2. Requirements

a. The field tester shall be a level III or greater.
b. The field tester shall meet the requirements of ANSI/TIA-568.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s instructions.

3.2 IDENTIFICATION / LABELING

A. General

1. Labels or tags containing a unique cable ID designator as specified on the drawings or herein shall be placed on both ends of all cables, 6 inches (152.4 mm) from the connector and/or terminal block.
2. Label or tag all cables passing through Telecommunications rooms.

3. Subsequent to placing and terminating cables, place the appropriate cable label.
4. The administration of the Telecommunications infrastructure includes:

    a. Labels (plates, tags, etc.) to identify individual components.
    b. Schedules (or other records (printed and/or in computer data base form) to document information about the individual components and the relationships between them.
    c. Plans or drawings to assist with visualizing the physical and/or logical locations of the components.

5. Provide labels on all applicable items installed under this work and to provide all related records and drawings so that the Owner will be able to administer the Telecommunications infrastructure.

B. Labeling Installation

1. Labels that are to be secured by adhesive shall have a type of adhesive that is appropriate for the particular surface upon which the label is to be installed. The mounting surface shall be free of dust, dirt, oil, etc. that would impede the adhesion of the labels.
2. Labels, plates and tags are to be installed in such a manner that they will be accessible, both physically and visually, after completion of the work. (Exception: It is understood that labels on the outlet end of station cables are generally not visible unless the face plates, bezel, module, etc., is removed or opened.)
3. Any temporary labels used during installation, cable pulling, etc. are to be removed and replaced by the permanent labels identified in Part 2 of this specification before the work will be accepted.
4. If at any time during the job the cable tag becomes illegible or removed for whatever reason during the construction period, immediately replace it with a duplicate pre-printed cable tag at the Contractor's expense before the work will be accepted.

C. Labeling Requirements

1. Labels, plates and tags are to be installed on:

    a. All Telecommunications rooms (spaces).
    b. All horizontal links and their components, including:

        1) Attaching a label no more than 6 inches (152.4 mm) from both ends of all horizontal cables installed under this work.
        2) Labeling/Color Coding of cable termination hardware (terminal blocks, outlets, patch panel jacks, etc.) installed under this work.
        3) Labeling/Color Coding of major termination assemblies (such as termination fields or frames, racks, etc.) installed under this work.
        4) Labeling the Telecommunications outlet housing individual connectors in the work area.

a) Labeling each connector terminating horizontal cables in these outlets.
b) Label identification within a given space (work area) shall begin at the entrance to the space and proceed in a clockwise manner around the space.

5) Any additional components required by ANSI/TIA-606

c. All components of the commercial grounding and bonding system for Telecommunications; to include but not limited to all bonding conductors, TMGB and TGB's.
d. All required fire stopping systems.
e. All pathways (e.g., inner duct, cable racking, conduit, etc.) installed under this work.

1) All interior pathways including cable trays and conduits shall be striped, traced, colored, or marked.

f. Provision of a database that records appropriate information regarding all cabling, terminations, frames, racks, etc. installed under this work.
g. In general, the label, plate or tag is to be provided and installed by whoever installed the item that is being labeled.
h. Refer to individual Telecommunications specification sections (Division 27) and to the Telecommunications drawings for additional information on labeling requirements.

3.3 TEST REPORTS FOR THE STRUCTURED CABLING SYSTEM

A. General cable testing

1. Pre-installation testing:

a. Visually inspect all cables, cable reels/boxes, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.
b. Where post-manufacturer test data has been provided by the manufacturer on the reel, box or shipping carton: submit copies to the Owner prior to installing cables.
c. Mark reels or boxes as tested/inspected and submit associated test results to Owner/Design Consultant.
d. Do not install any cable with less than the manufacturer's guaranteed number of serviceable conductors.

2. Post-installation testing:

a. Calibrate all testers prior to use in accordance with manufacturers' printed instructions.

b. Conduct cable testing as described below upon completion of installation. Test fully completed systems only. Piecemeal testing is not acceptable.
c. Remove all defective cables from pathway systems. Do not abandon cables in place.

3. All test results and corrective procedures are to be documented and submitted to the Owner within five (5) working days of test completion.

a. Prior to testing, submit for review and approval copies of test report forms proposed for use.
b. Each test report shall contain the following general information: Date of Preparation, Date of Test, Project Name, Contractor's Name, Media Type, Make, Model and Serial Number of test equipment used, Date of Last Calibration and Names of Test Crew.

B. Copper cable testing

1. Perform all manufacturer recommended and required test calibration procedures prior to testing any cables.
2. Paired and multi-conductor riser metallic cables:

a. After terminating and splicing the cables. Test all cable pairs for continuity, ground fault, proper cross-connection, shorts and crossed pairs.
b. After installing cross-connects, perform end-to-end testing of each cross-connected cable pair for continuity, ground fault, proper cross-connection, shorts and crossed pairs.
c. Cable test reports: As a minimum, also provide: cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair, results of each test for each pair or conductor, total number of serviceable pairs or conductors in cable.

3. Four-Pair Cables:

a. After terminating both ends of all 4-pair cables, but before any cross-connects are installed, test these cables for the following:

1) Category 6 UTP

a) Wire map
b) Length
c) Insertion loss
d) Near-end crosstalk (NEXT) loss.
e) Power sum near-end crosstalk (PSNEXT)
f) Equal-level far-end crosstalk (ELFEXT)
g) Power sum equal-level far-end crosstalk (PSELFEXT)
h) Return loss
i) Propagation delay
j) Delay skew

4. After installing cross-connects, perform end-to-end testing of each cross-connected cable for continuity, ground fault, proper cross-connection, shorts and crossed pairs. For 100 pair or smaller cables, replace entire cable if bad pair is found. For larger pair-count cables, replace if more than 1% of pairs are bad.
5. Submit the following information regarding the cable testing: cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair (if applicable), results of each test for each pair and total number of serviceable pairs in cable.
6. In addition to the tests specified above, provide a minimum of two suitably qualified cabling technicians and copper test equipment to be present on-site for a period of 2 hours during the Design Consultant's Substantial Completion Review. Be prepared to conduct on-the-spot cable tests as requested. Successful equipment performance tests do no relieve the Contractor from the specified testing, repair, and documentation requirements.

C. Acceptance

1. The Owner and Design Consultant reserve the right to observe the conduct of any or all portions of the testing process.

    a. The Owner and Design Consultant further reserves the right to request the Contractor conduct a random re-test of up to ten percent (10%) of the cable plant to confirm documented test results during the Substantial Completion Review. If more than one of these randomly tested cables do not pass, the Owner and Design Consultant reserves the right to require a re-testing of 100% of the cable plant, all without additional costs to the project.

2. For 100 pair or smaller replace entire cable if a bad pair or conductor is found. For larger pair count cables, replace if more than 1% of pairs are bad.
3. All test results are to be documented and submitted to the Architect in a timely manner, in accordance with the Submittal instructions in Part 1 of this section.

    a. Corrective procedures following the Substantial Completion Review shall be properly documented, and affected and new cables shall be retested prior to Substantial Completion.
    b. Updated complete Test Results, including retested, new and unaffected cables, shall be included in the Final Project Completion submittal.

3.4 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:

1. The complete build-out of all Communications Rooms, cleaned of dust and debris.
2. Installation, termination, final labeling, and testing of all backbone and horizontal cabling.

3. The installation and labeling of all firestopping systems required for Telecommunications cabling and outlets. If firestopping was provided by a separate contractor (per Division 27 “Common Work Results for Communications”), ensure all firestopping systems are installed and labeled.
4. The installation, labeling, and testing of the Telecommunications Grounding and Bonding System.
5. Ensure faceplates are level, free of dust and paint, match color/style of adjacent electrical receptacle, and have blue protective film removed.
6. Update jobsite Work Prints with all individual port / cable IDs, which shall correspond to the cable IDs in the Test Results.

    a. These shall then be scanned to PDF (minimum resolution of 150 dpi) to be included in the Preliminary Project Completion documentation outlined in the Part 1 Submittal requirements earlier in this section.

B. Request in writing a review for Substantial Completion. Refer to Part 1 Submittal requirements earlier in this section for required notice and Preliminary Project Completion documentation that shall be included with this request.

C. State in the written request that the Contractor has complied with the requirements for Substantial Completion for the (Telecommunications) Structured Cabling System.

D. Upon receipt of a request for review, the Architect will either proceed with the review or advise the Contractor of unfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, then provide reimbursement to the Architect and Design Consultant for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect and Design Consultant will prepare a “final list” of outstanding items to be completed or corrected for final acceptance. Omissions on the “final list” shall not relieve the Contractor from the requirements of the Contract Documents.

3.5 SPECIAL TOOLS

A. Delivery to Owner’s representative 2 complete sets (UON) of all special tools and small equipment items needed for proper operation, adjustment and maintenance of cabling and equipment installed under this work. All tools to be new and still in manufacturers packaging. The cost for these tools is to be included within the bid price for this work.

B. The terms “special tools” and “small equipment items” is meant to include such items as punch down tools, connector assembly tools, etc. with each individual item having a retail replacement cost not exceeding five hundred dollars ($500.00). It is NOT meant to include common hand tools such as standard screwdrivers, pliers, wrenches, etc.

END OF SECTION 271000

SECTION 271100 - TELECOMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Section includes fittings that are within the physical walls of the communications equipment rooms to support the Telecommunications System. Fittings include but are not limited to:

1. Termination Blocks and Patch Panels

B. Section does not specify fittings such as cables, cable terminations, termination blocks, and patch panels for structured cable system (SCS). These components are specified in the Division 27 Section “Communications Backbone Cabling” and Division 27 Section “Communications Horizontal Cabling”.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING

A. Follow all applicable codes, references, and standards listed in Division 27 Sections “General Communications Requirements” and “Structured Cabling System”.

1.3 DEFINITIONS

A. Communications Equipment Room – This CSI MasterFormat™ term shall apply to spaces specifically designed to maintain communications equipment. This definition shall encompass ANSI/TIA-569 terms for Entrance Room, Common Equipment Room (CER), and Common Telecommunications Room (CTR). This definition also shall encompass BICSI Telecommunications Distribution Methods Manual terms for Telecommunications Room (TR), Telecommunications Enclosure (TE), Equipment Room (ER), and Entrance Facility (EF).

B. Communications Entrance Protection – Fittings that reduce risk to life, limb, or property by protecting against power surges. This definition shall encompass protection devices and fittings described in Article 770 “Optical Fiber Cables and Raceways” and Article 800 “Communications Circuits” of NFPA 70 “National Electrical Code”.

C. Communications Cabinet – A floor or wall mount unit enclosed with side panels. Communications equipment is supported by mounting rails separated at 19” or 23” inches.

D. Communications Rack – A floor or wall mount unit without side panels. Racks can be 2-post or 4-post. Communications equipment is supported by mounting rails separated at 19” or 23” inches.

E. Communications Frame - A floor or wall mount unit without side panels. Communications termination blocks are the only communications devices mounted to the unit.

F. Communications Enclosure – A floor or wall mount unit enclosed with side panels. Communications equipment is not supported by mounting rails separated by 19" or 23" inches. This definition shall encompass BICSI Telecommunications Distribution Methods Manual term for Telecommunications Enclosure (TE).

G. Ground or Grounding – A conducting connection, whether intentional or accidental, between an electrical circuit (e.g. telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.

H. Grounding Equilizer (GE) – The conductor that interconnects elements of the telecommunications grounding infrastructure.

I. Telecommunications Bonding Backbone (TBB) – A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar.

J. Telecommunications Main Grounding Busbar (TMGB) – A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

1.4 SUBMITTALS

A. Follow the requirements for submittals in Division 27 Sections "General Communications Requirements" and "Structured Cabling System".

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of device from a single manufacturer and through one source. Where practical and possible, obtain all devices from a single manufacturer and one source.

B. Communications equipment room fittings shall be listed by a NRTL.

PART 2 - PARTS AND MATERIALS

2.1 ANSI/TIA-607-COMPLIANT TELECOMMUNICATIONS GROUNDING AND BONDING SYSTEM

A. General

1. Provide a complete functioning telecommunications grounding and bonding system, including every article, device, or accessory (whether or not specifically

called for by item) reasonably necessary for the system to be in compliance with the ANSI/TIA-607 Standard "Generic Telecommunications Bonding and Grounding for Customer Premises". Major components include:

a. TMGB in the Main Telecommunications Room and TGBs in all remaining Telecommunication Rooms and Spaces.
b. BCT connecting the TMGB to the main Electrical Service Ground.
c. TBB connecting the TMGB to all TGBs.
d. All equipment and pathway grounding and bonding connections as identified on the drawings, recommended by manufacturers of equipment installed under this section, and stipulated in the referenced standard.

2. Component Manufacturer[s]:

a. Chatsworth
b. Cooper B-Line
c. Erico
d. Harger
e. Hoffman
f. Panduit

3. Conductor Manufacturers

a. Shall be from the list of Component Manufacturers; or
b. Shall be from the list of Manufacturers in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

B. Connectors / Connections

1. Specifications

a. All connectors and connections shall utilize products that are Listed by a NRTL such as UL.
b. All connectors shall have twin clamping elements for cable; two holes for attachment to grounding bar, etc.

2. Compression Lugs

a. Specifications

1) Shall be manufactured from electro-plated tinned copper for use with copper conductors.
2) Shall include inspection port.
3) On center dimension between holes (O.C. Dim. B/T Holes) shall be 0.625" ("A" Pattern) or 1" ("C" Pattern)

b. Manufacturer shall be:

1) Harger GECLB Series

2) Or Approved Equivalent

3. Conductor to conductor connection

a. Specifications

1) All connections between conductor and the joining or mating of cables to connectors shall be done by exothermic weld or irreversible compression connector.

b. Manufacturer – Exothermic Weld

1) Erico CADWELD
2) Harger Ultraweld
3) Or Approved Equivalent

c. Manufacturer – Irreversible Compression connector

1) Burndy HYGROUND
2) Or Approved Equivalent

4. Connector for conduit to cable

a. Specifications

1) All continuous conduits (except entrance conduits) which extend into the Telecommunications Room shall be fitted with a pipe clamp or conduit bonding clamp connected to the TMGB/TGB.

b. Manufacturer shall be:

1) For 1” diameter and larger conduits – Harger series CPC electro tin-plated pipe lamp
2) For less than 1” diameter conduits – Harger TBGC4SCS elctro tin-plated conduit bonding clamps
3) Or Approved Equivalent

5. Connector for conductor to cable tray

a. Specifications

1) For metallic cable trays that extend to the Telecommunications Room.

b. Manufacturer shall be:

1) Harger electro tin-plated cable tray bonding clamps – TBCTC
2) Or Approved Equivalent

C. Insulated Grounding Bushings

1. Specifications

    a. All communications entrance conduits that extend into the Telecommunications Room shall be fitted with an Insulated Grouding Bushing.
    b. Shall be UL Listed for copper conductors.
    c. Shall include lug for easy connection of conductor to TMGB/TGB.

2. Manufacturer shall be:

    a. O-Z/Gedney IBC-L
    b. Or Approved Equivalent

2.2 TELECOMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

A. General

1. All telecommunications termination blocks and patch panels shall be by the same manufacturer and covered under the same Advanced Structured Cabling System Warranty.

    a. The following manufacturers are Conditionally Approved:
    b. <insert Owner's standard manufacturer>[, no substitutions]
    c. [Refer to Advanced System Warranty sub-section of Division 27 "Structured Cabling System" for list of approved connectivity manufacturers] <copy and past list from 271000>
    d. [Or Approved Substitution (submitted and accepted in the "pre-bid" phase)]

B. Rack-mount Modular - Copper Patch Panels

1. General Requirements for Patch Panels: Comply with referenced standards. Cables shall be terminated with connecting hardware of same category or higher.
2. Patch panels shall be provided complete with all mounting hardware, jacks, retainers, wire guides, designation strips, etc.
3. Patch panels shall accept modular jacks of exactly one port, and this modular jack shall be the same type as being installed at the far-end faceplates.
4. Provide enough ports for the number of cables terminated on the patch panel, plus [25] <Insert number> percent spare. Provide all connector blocks', including plugs and jacks where required to fill each panel completely. Do not leave any blank openings.
5. Modular Patch Panels shall be of a metal design with snap in module frames for each individual jack.
6. Ports and panels shall be easy to identify with label holders for machine-printed and color-coded labels. Rack mountable patch panels shall mount to standard EIA 19" racks.
7. Horizontal Cabling

a. Four-pair [Augmented Category 6] [Category 6] [Category 5e] UTP cabling shall be terminated onto a four-pair [Augmented Category 6] [Category 6] [Category 5e] jack module. All jack modules shall be terminated using the [T568A] [T568B] wiring scheme. The eight-position jack module shall exceed the connector requirements of the TIA [Augmented Category 6] [Category 6] [Category 5e] standard.

8. [Submit Manufacturer and part number as part of pre-construction submittals.] <designer to insert specific Manufacturer & Part number>

2.3 TELECOMMUNICATIONS PATCH CABLES & CROSS-CONNECT WIRES

A. General

1. Supply all necessary patch cables and cross-connect wires as part of a complete and functioning telecommunications system to support voice, data, audio-video, security, and other miscellaneous systems.
2. The manufacturer of patch cables shall be the same as the telecommunications connectivity, unless otherwise specified.
3. All patch cables shall be factory-terminated and tested.

B. Copper Cross-Connect Wires

1. Provide cross-connect wires as indicated on the drawings and as required to form a complete and functioning telecommunications system. This includes extension of analog voice lines from the service provider demarcation point to the following connections:

a. Fire Alarm Control Panels
b. Elevator phones
c. Fax machines – assume at least one fax machine location [per floor] on the project; coordinate final location(s) with Owner during construction
d. [Emergency analog phone locations]
e. [Security Panels]
f. <insert locations>

2. Manufacturer shall be:

a. Same as copper connectivity or backbone cabling manufacturer
b. Submit product cutsheet for review

C. Copper Patch Cords

1. Category performance shall be the same as copper patch panels.
2. Cable shall be 4-pair, twisted pair with factory-terminated RJ-45 modules on each end.

3. Provide (furnish and install) all patch cords required for the following connections and systems (coordinate color, length, and quantity with sub-contractors of those systems):

    a. Fire Alarm Control Panels
    b. Elevator Phones
    c. Fax Machines
    d. [Emergency analog phone locations]
    e. LAN connections for Audio-Video Systems equipment
    f. LAN connections Security Systems equipment [and cameras]
    g. <insert other locations/systems>

4. Furnish patch cords to the Owner prior to substantial completion in the following lengths and quantities:

    a. Total quantity shall be [100%] [75%] [50%] of the terminated ports, in the following colors and lengths:

        1) One-fourth shall be 3' and yellow
        2) One-fourth shall be 3' and blue
        3) One-fourth shall be 7' and blue
        4) One-fourth shall be 10' and blue

5. Manufacturer shall be:

    a. Same as copper connectivity manufacturer
    b. Submit product cutsheet for review

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

3.2 GROUNDING AND BONDING INSTALLATION

A. General:

1. Install all other ground conductors (wire) without splices or mechanical couplers installed between the wire points of origin and termination except as shown on the Drawings and/or specified herein. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located in Telecommunications rooms (spaces). Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage. "Daisy chaining" of Telecommunications ground bus bars back to the

TMGB will not be accepted unless specifically indicated on the Telecommunications drawings or specified herein

2. Unless otherwise noted, all ground wires shall be routed through the Telecommunications cable management pathways so as to achieve a “coupled bonding conductor” effect
3. Where insulated conductors are necessary provide adequately rated insulation jackets or pathways to meet all required building codes. (I.e. Plenum, riser, outside plant, run entirely in conduit, etc.)
4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds 3 feet (1 meter) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum.
5. The Bonding Conductor for Telecommunications (BCT), each Telecommunications bonding backbone (TBB) conductor, and each grounding equalizer (GE), shall be green or marked with a distinctive green color

    a. Marking with a distinctive green color Shall be done at a minimum of every 1 foot (0.3 meter) by appropriate methods
    b. Indicate proposed and actual routing of these conductors on overall floor plans in both the pre-construction Shop Drawings and Record Drawings, respectively.

6. Follow additional installation requirements from NECA/BICSI 607-2011 “Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings”.

B. Required Grounding Connections:

1. Provide and install one individual ground wire from each equipment rack/cabinet/frame (installed under this work) to the TGB in the room. Each conductor is to be “home run”; do not “daisy chain” the connections, except as may be indicated on the drawings.
2. Provide and install one individual ground wire from the raised floor system (if applicable) to the TMGB. Conductor is to be “home run”; do not “daisy chain” the connections, except as may be indicated on the drawings.
3. Provide and install one individual ground wire from the overhead and vertical ladder racking (installed under this work) to the TGB in the room. All sections of ladder rack shall be securely connected together; otherwise, provide ground wire from each section of ladder rack.
4. Where structural steel is available for connection install one individual ground wire to the nearest structural steel for connection.
5. Provide and install all grounding connections as required by Telecommunications set of drawings.

C. Connector Installation:

1. Provide all ground wire connectors as shown on the Drawings or as indicated herein, unless otherwise noted.
2. Follow the connector manufacturer's instructions for installing the connector to the cable and the connector to the cabinet/rack, ground bar, etc. Use the appropriate tools for the job, tighten nuts/bolts to proper torque, remove paint, insulation, oxidation as needed to assure good metal to metal contact, etc. If the manufacturer does not provide tightening specifications, follow the recommendations of UL Standard 486.

D. Cable Identification:

1. Label both ends of each ground conductor within 6 inches (152.4 mm) of a connector terminal or splice. Label the grounding conductors as shown on the Drawings or specified herein. All labels shall include the following in addition to specific labeling requirements for each conductor.

IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER

E. Quantities of Ground Wires (Conductors)

1. Location and placement of grounding and bonding wires and components shall be as shown on the Drawings or defined herein.
2. Quantities of ground wires, bonding components, etc. shown on the drawings are illustrative only and are meant to indicate the general configuration of the work. Provide the correct quantities of materials to construct a grounding and bonding system that meets the intent of these Specifications and the relevant codes.

F. Sizing of Ground Wires (Conductors)

Subject to the applicable electrical code and the reference standards and guidelines, the BCT, TBB, GE conductors (if applicable), and conductors to serving electrical panels and building steel shall be sized per the following table (Table 1 from ANSI/TIA-607):

Linear Length (ft)	AWG Size
less than 13	6
14-20	4
21-26	3
27-33	2
34-41	1
42-52	1/0
53-66	2/0

67-84	3/0
85-105	4/0
106-125	250 kcmil
126-150	300 kcmil
151-175	350 kcmil
176-250	500 kcmil
251-300	600 kcmil
Greater than 301	750 kcmil

G. Testing

1. As a minimum test, as described below, all metallic wires and cables installed under these Specifications.
2. Test the grounding conductor and the terminal connectors for total resistance between the equipment item being grounded and the main telecommunications grounding point in the room. This resistance Shall be less than 0.10 Ohm.
3. Recommended test equipment (obtain approval of Owner/ Design Consultant prior to using substitute test equipment):

    a. An ohmmeter capable of indicating resistance down to 10 milli-ohms or below.

H. Acceptance

1. Upon receipt of the Contractor's documentation of cable testing, the Owner/ Design Consultant will review/observe the installation and randomly request tests of the cables/wires installed. Once the testing has been completed and the Owner/ Design Consultant is satisfied that all work is in accordance with the Contract Documents, the Owner will notify the Contractor in writing.

I. Record Drawings

1. The Project Record Drawings shall show the types and locations of installed grounding and bonding conductors.

3.3 QUANTITIES OF RACK/CABINET AND DISTRIBUTION FRAME EQUIPMENT AND COMPONENTS

A. Location and placement of communications equipment room fittings shall be as shown on the Drawings or defined in these specifications and schedules.

B. Quantities and sizes of communications equipment room fittings shown on the Drawings are illustrative only and are meant to indicate the general configuration of the work. Provide the correct quantities of all materials necessary to accommodate the work described in these specifications and schedules and shown on the Drawings.

C. Equipment racks, cabinets and distribution frames shall be assembled and installed as per the manufacturers' printed instructions.

END OF SECTION 271100

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Provide a complete Category 6 horizontal (work area) telecommunications cabling system as shown on the T sheets and in accordance with these Contract Documents.

B. This section specifies the following:

1. Horizontal Copper Cable
2. Copper Connectivity

    a. Faceplates
    b. Modules/jacks/inserts

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions, requirements, and recommendations in Division 27 Section “General Communications Requirements”

B. Refer to Division 27 Section “Common Work Results for Communications” for general pathway, firestopping, access panel, identification, and other requirements.

C. Refer to Division 27 Section “Structured Cabling System” for Advanced System Warranty information and other requirements.

D. Refer to Division 27 Section “Telecommunications Equipment Room Fittings” for telecommunications equipment racks, patch panels, wall-blocks, surge suppressors, and other equipment room requirements.

1.3 CODES, STANDARDS, AND GUIDELINES

A. In addition to all applicable codes, standards, and guidelines listed in Division 27 Sections “General Communications Requirements” and “Structured Cabling System”, follow the most recent editions of the following:

1. NFPA 70 (NEC) – “National Electrical Code” (NEC)
2. IEEE NESC - “National Electrical Safety Code”
3. ANSI/BICSI 005 – “Electronic Safety and Security System Design and Implementation Best Practices”
4. ANSI/NECA/BICSI-607 – “Standard for Telecommunications Bonding and Grounding Planning and Installation methods for Commercial Buildings”

5. ANSI/TIA-568 – “Commercial Building Telecommunications Cabling Standard Set”
6. ANSI/TIA-569 – “Commercial Building Standard for Telecommunications Pathways and Spaces”
7. ANSI/TIA-607 – “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”
8. ANSI/TIA-606 – “Administration Standard for Commercial Telecommunications Infrastructure”
9. BICSI – “Telecommunications Distribution Methods Manual”
10. BICSI – “Information Technology Systems Installation Methods Manual”
11. IEEE 142 – “Recommended Practice for Grounding of Industrial and Commercial Power Systems” (Green Book)
12. IEEE 1100 – “Recommended Practice for Powering and Grounding Electronic Equipment” (Emerald Book)

1.4 DEFINITIONS

A. Advanced System Warranty – refer to Division 27 Section “Structured Cabling System”.

B. Communications Equipment Room - This CSI MasterFormat term shall apply to spaces specifically designed to maintain communications equipment. This definition shall encompass ANSI/TIA-569 terms for Entrance Room, Common Equipment Room (CER), and Common Telecommunications Room (CTR). This definition also shall encompass BICSI Telecommunications Distribution Methods Manual terms for Telecommunications Room (TR), Telecommunications Enclosure (TE), Equipment Room (ER), and Entrance Facility (EF).

C. Direct Attach Method – as defined in ANSI/BICSI 005-2013, the horizontal cabling on the remote device end directly attaching (or connecting) to the device through a connectorized cable or hard-wired termination, eliminating the workstation outlet, jack and equipment cord.

D. Horizontal Cabling

1. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

    a. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector
    b. Bridged taps and splices shall not be installed in the horizontal cabling
    c. Splitters shall not be installed as part of the optical fiber cabling

2. A work area is approximately 100 sqft (9.3 sqm), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
3. The maximum allowable horizontal cable length is 295 feet (90 meter). This maximum allowable length does not include an allowance for the length of 16 feet (4.88 meter) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.88 meter) in the horizontal cross-connect.

E. Structured Cabling / Telecommunications System – a fully-functional passive telecommunications system (infrastructure), that includes permanently installed copper Category and fiber optic cable terminated onto a patch panel or outlet.

1.5 QUALITY ASSURANCE

A. As a minimum, the person(s) conducting the testing for all Telecommunications cabling shall be a current BICSI Certified Level II Commercial Installer or higher.

B. All testing equipment used shall have the latest version of software and/or firmware installed prior to testing any cabling. Testing equipment shall also undergo all manufacturers' required and recommended routine maintenance.

1.6 SUBMITTALS

A. Follow the requirements for submittals in Division 27 Section "General Communications Requirements"

B. The following submittals are due at the "pre-bid" phase submission

1. For all products for which a substitute is to be considered as an approved equivalent or acceptable substitution provide submittals with sufficient detail for review by the Engineer. Submittals shall at a minimum provide detailed information substantiating all performance requirements as well as all necessary code compliance and NRTL listing information.

C. The following submittals are due at the "pre-construction" phase submission

1. Provide a typed list indicating part name, manufacturer, part number, and color (if applicable) for products specifically identified herein by the exact and complete part number (no wild-card characters)
2. Submit manufacturers' cut sheets or catalog cut sheets for:

a. Each of the cables specified. Cut sheets shall include the following information at a minimum:

1) Manufacturers name and logo
2) Cable outside diameter

3) Number of conductors/strands in each cable and binder group
4) Gauge or strand thickness
5) Minimum transmission performance rating
6) Cable jacket material and rating
7) Maximum pulling tension
8) Jacket/Sheath color
9) Individual conductor or strand insulation colors
10) Minimum bend radius

a) During installation and post installation.
b) As well as any additional information required by individual sections of this Division.

b. Faceplates and modules. Cut sheets shall include the following information at a minimum:

1) Manufacturers name and logo
2) Material type
3) Performance rating
4) Physical Dimensions
5) Color

c. Product information of test equipment to be used for the testing of cabling.
d. Provide documentation indicating manufacturer required and recommended maintenance and calibration services and intervals at which these services shall be performed.

1) Provide documentation indicating the dates at which all testing units have undergone these services. For services required on a daily or pre-test basis provide documentation on the procedures the contractor will undergo for performing such services.

3. Shop Drawings

a. Submit for review scaled layout drawings showing the routing of all cabling, and the locations where terminal blocks, patch panels, Telecommunications outlets, cable types, cable jacket listing information, firestop locations (with quantity and NRTL system number identified), furniture feed points, and fiber optic termination panels are to be installed.
b. Shall show the number of horizontal cables served by each room and the number of patch panels and termination blocks to be installed (including those to accommodate 25% growth).
c. Each individual outlet on the drawings shall have proposed outlet identification indicated.
d. Unless otherwise required by these specifications, it is permissible to show different cabling systems (voice, data, CATV, A/V) on the same shop drawing.

4. Testing

    a. Qualifications: Identity and qualifications of the personnel who will perform the testing as required above in the Quality Assurance paragraph.
    b. Submit all physical characteristics needed for appropriate testing setup and verification. I.e. Nominal velocity of propagation (NVP) for each and every cable type. This parameter shall be identified and submitted for review. Such submittals for all parameters shall be from printed manufacturers' cut-sheets or other manufacturers' printed material.
    c. Submit the proposed schedule for performing testing at least 2 weeks prior to the start of testing.

5. Sample warranty information as indicated herein and elsewhere in this Division.

D. The following submittals are due at the "Project Completion" phase submission

1. As-built Drawings

    a. Submit scaled layout drawings showing the routing of all cabling, and the locations where terminal blocks, patch panels, Telecommunications outlets, cable types, cable jacket listing information, firestop locations (with quantity and NRTL system number identified), furniture feed points, and fiber optic termination panels have been installed.
    b. Shall show the number of horizontal cables served by each room and the number of patch panels and termination blocks installed (including those to accommodate 25% growth).
    c. Unless otherwise required by these specifications, it is permissible to show different cabling systems (voice, data, CATV, A/V) on the same As-built drawing.

2. After approval by the Owner, submit the test results in computer readable copy in CD, DVD or mutually acceptable format by the Contractor and Owner.
3. Advanced Structured Cabling System Warranty Certificate

1.7 WARRANTIES

A. Provide manufacturer warranties as required in Division 27 Section "Structured Cabling System".

PART 2 - PRODUCTS AND MATERIALS

2.1 HORIZONTAL (WORK AREA) COPPER CABLE

A. Horizontal cables for dry environments

1. Requirements

a. Unshielded Twisted Pair (UTP)
b. Minimum performance specifications: Cable shall meet requirements for Category 6 of ANSI/TIA-568.
c. Four pairs of 22-24 AWG solid copper conductors
d. Cable jacket color(s) shall be

1) Blue for all cables

e. Cable jacket marking: Shall be legible and shall contain the following information:

1) Manufacturer's name
2) Copper Conductor Gauge
3) Pair Count
4) UL and CSA listing
5) Manufacturer's trade mark
6) Category rating
7) Sequential distance markings, in one foot increments

f. Individually insulated conductors under a common sheath
g. Plenum (CMP or MPP) rated.

2. Manufacturer shall be:

a. Belden Incorporated
b. CommScope Inc.
c. Legrand/Ortronics
d. Leviton
e. Panduit
f. Siemon
a. Submit product data from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements)

B. Horizontal cables for Wet Locations (as defined in Division 27 Section "Structured Cable System")

1. Requirements

a. Suitable to be in contact with standing water
b. Cable construction shall be consistent with manufacturer's requirements to be covered under warranty specified in Division 27 Section "General Communications Requirements".
c. Minimum performance specifications: Cable shall meet requirements for Category 6 of ANSI/TIA-568.
d. Cable jacket marking: Shall be legible and shall contain the following information:

1) Manufacturer's name
2) Copper Conductor Gauge

3) Pair Count
4) UL and CSA listing
5) Manufacturer's trade mark
6) Category rating
7) Sequential distance markings, in one foot increments

2. Product shall be:

a. Submit product data from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements)

2.2 FACEPLATES FOR COPPER CONNECTIVITY

A. Single-gang faceplate:

1. Requirements

a. Stainless Steel with number of ports to allow all modular jacks to be installed as required, and as indicated on the drawings.
b. Color shall match electrical, U.O.N. by owner
c. Single gang, U.O.N

2. Product shall be

a. Submit product data from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements)

B. Weatherproof faceplate:

1. Requirements

a. Water resistant faceplate (to IP56 rating, or equivalent) with number of ports to allow all jacks to be installed as required, and as indicated on the drawings.
b. With in-use cover

2. Product shall be:

a. Panduit Mini-Com Water Resistant Faceplate with integral cover.
b. Hubbell RW57300 (Or Approved Equivalent) with decora-insert and jacks from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements).

2.3 COPPER CONNECTIVITY

A. Modular jacks

1. Requirements

    a. Outlets shall meet requirements for Category 6 of ANSI/TIA-568.
    b. All 8-position modular jacks are to be wired according to the TIA T568A/B pin/pair assignments.
    c. Outlet hardware shall be UL listed.
    d. One port
    e. Color shall match electrical, U.O.N. by owner

2. Product shall be

    a. Submit product data from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements)

B. Blank inserts

1. Requirements

    a. Provide blank modules to fill any unused openings in faceplates
    b. Color shall match other jack colors

2. Product shall be

    a. Submit product data from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements)

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

3.2 CABLE INSTALLATION

A. General

1. Place all horizontal cabling in accordance with these specifications, on the Drawings, and as indicated on any cable schedules
2. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications.

    a. There shall be no splices or mechanical couplers installed between the cable points of origin and termination except as shown on the Drawings and/or specified herein.
    b. There shall be no Bridged taps (multiple appearances of the same cable pairs at several distribution points) installed.

1) Horizontal cabling shall be terminated in a Telecommunications room that is on the same floor as the area (outlet) being served in accordance with ANSI/TIA-568.
2) No horizontal cables shall exceed the allowed maximum distance of 295 feet (90 meters) by ANSI/TIA-568.

3. Unless otherwise noted, all cables shall be routed through the building cable tray/conduit/surface-mounted raceway system. Refer to the electrical drawings for the layout of the conduits. Refer to the Telecommunications drawings for layout of cable tray.

   a. All horizontal cables shall be plenum (CMP, MPP, OFNP, or OFCP) rated. UON
   b. Horizontal cables installed in “wet” locations as defined by the NEC or in these construction documents (such as conduits embedded or routed below a ground floor slab) shall be suitable for installation in such environments and follow the installation requirements for outside plant cables as specified herein.

4. Cables shall remain unattached to pathways or other cables and shall simply lay at rest on the supports provided by its pathway (including cable trays, wire basket, j-hooks, conduit, etc.). Wire ties, velcro straps, electrical tape or any other method shall not be used to attach cables to cable supports or to create cable bundles.

   a. Except when supported by ladder racking within each Telecommunications room, UON.

5. At the same time horizontal cables are pulled into a conduit also install a pull cord to facilitate future cable pulls along those. Use polypropylene or monofilament plastic line with not less than 200 lb (90.72 kg) tensile strength. Leave at least 12 inches (304.8 mm) of slack at each end of pull cord.
6. Do not install kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable
7. Comply with all referenced standards and guidelines.
8. Cables shall be masked, covered, or otherwise protected from being painted or coming in contact with any other substance that may degrade the performance or physical characteristics of the cable jacket or insulation over time.
9. Where distance allows all horizontal cables shall be provided with slack/service loops at each end of the cable, one at the work area outlet and one at the Telecommunications room/enclosure. Each slack/service loop shall be:

   a. A minimum of 8 feet (2.44 meter) in length, UNO
   b. Configured in a loosely formed figure eight configuration (i.e. not coiled)

10. Prior to using any cable pulling lubricants provide the Engineer with written documentation from the cable manufacturer supporting the cable manufacturers’ acceptance of its use in compliance with all required warranties as part of these

contract documents. The use of non-water based lubricants shall be provided when pulling PVC jacketed and all cables not suitable for contact with water.

B. Outside plant cable installation: for cables placed in “wet locations” or as required by these construction documents. (I.e. all cables which extend beyond the footprint/envelope of the building or pathways leading to floor-boxes embedded in a ground floor slab)

1. Unlisted cables shall transition to an indoor rated cable within 50 feet (15.24 meter) of the entrance point as required the NEC.

a. This 50 feet (15.24 meter) allowed by code is only to allow termination as close as practicable to the entrance point. Terminate all outdoor only (unlisted) cables at the closest point of entrance and transition to an indoor rated cable to extend to additional Telecommunications rooms (spaces)

2. No portion of outdoor only (unlisted) cables may be installed with the cable jacket exposed in any plenum or other air handling space nor shall they be allowed to transition between different levels of the building.
3. Where specifically allowed by these construction documents cable jackets rated for dual use by a NRTL, such as an indoor/outdoor rated cable may be used.

a. These cables may be installed in locations within the building in which the cable jacket is appropriately rated to meet all applicable building codes.

4. Rigid metallic conduit shall be used to route outdoor (unlisted) cabling to within 50 feet (15.24 meter) of the transition point to indoor rated cabling in accordance with the NEC.
5. All cables which extend beyond the envelope/footprint of the building shall be installed with entrance protectors in accordance with Division 27 Section “Communications Equipment Room Fittings”

C. Horizontal (work area) Cables:

1. From the appropriate Telecommunications room, provide each work area outlet, the types and quantities of horizontal cables as described in the applicable system specification sections. Cables will leave the Telecommunications room via cable tray, conduit/sleeve or floor duct. Each cable will be terminated except for pay phone and elevator machine room junction box locations.
2. Install all horizontal cables in accordance with Division 27 Section “Common Work Results for Communications” and as indicated on the drawings.

3.3 CABLE & WIRE INSTALLATION

A. General:

1. Place all station cabling in accordance with these specifications, and as indicated on the cable schedules and the Drawings.

B. Station Cables:

1. Install station cabling, outlets and jacks as detailed in the horizontal cable placement schedules and the Drawings. The typical configuration for outlets shall be two unshielded twisted pair (UTP) cables of 4-pairs each, unless otherwise noted on the drawings or the Horizontal Cable Placement Schedules.

C. Cables located in “wet” locations

1. Provide all required entrance protection in accordance with Division 27 “Communications Equipment Room Fittings”.
2. Follow the requirements for installing outside plant rated cable as specified in Division 27 Section “Communications Horizontal Cabling”
3. All cables routed to floor boxes in the slab shall route to a transition box within 50 feet (15.24 meter) of where the conduit emerges from the slab. Provide connecting hardware within an appropriately rated enclosure to allow a transition from outside plant cable to indoor rated cable. Indoor rated cable shall be rated as required by building code and as specified herein. Route indoor cables as indicated for horizontal cable distribution. Transition hardware shall meet or exceed the category performance of the highest rated cable being terminated.

    a. Cables from multiple different floor boxes may be routed to a single, appropriately sized, transition enclosure.

3.4 CONNECTOR INSTALLATION

A. Furnish and install all cable connectors as shown on the Drawings.

B. Provide number of connectors as required by the Drawings and as required by these documents, where the number of connectors required does not fill the entire faceplate provide blank inserts so that no opening is left.

C. The provision and termination of connectors from each cable shall be done as follows:

1. Where connector types are identified on the applicable drawings or in the specifications, furnish and install the specified connectors on the specified cables. Installation of the connectors shall be in accordance with the manufacturer’s printed instructions.
2. All installed connectors, regardless of type, method of procurement or permanency, shall be adequately protected during and after installation.

D. Copper Connector Installation

1. Terminate all four pairs of each cable on one outlet jack.
2. Furnish and install all cable connectors as shown on the Drawings or as indicated herein, unless otherwise noted.
3. The provision and termination of connectors for each cable shall be done as follows:

a. Where connector types are identified on the applicable drawings or in the specifications, Furnish and install the specified connectors on the specified cables. Installation of the connectors shall be in accordance with the manufacturer's printed instructions.
b. All installed connectors, regardless of type, method of procurement or permanency, shall be adequately protected during and after installation.

3.5 FACEPLATE INSTALLATION

A. Furnish and install all faceplates in locations as shown on the Drawings.

3.6 CABLE IDENTIFICATION

A. Label all horizontal cabling with machine-printed labels according to the labeling scheme identified on the drawings. Where the drawings are silent, submit RFI through appropriate channels requesting labeling scheme.

1. Shop drawings shall include floor plan that indicates proposed cable/outlet identification for each outlet.

B. Cables shall be labeled within 6" at each end.

C. All cable labels shall be thermal-transfer type and utilize self-adhesive labels. The following are approved manufacturers:

1. Brady, IDXPERT
2. Hellermann Tyton, Spirit 2100
3. Panduit LS9
4. Or equivalent

3.7 CABLE TERMINATIONS

A. Terminate all horizontal cables in accordance with Division 27 Section "Communications Equipment Room Fittings". No cables shall contain unterminated elements UON.

3.8 CABLE TESTING

A. Refer to Division 27 Section "Structured Cabling System" for testing requirements.

3.9 ACCEPTANCE

A. The Owner and Design Consultant reserves the right to observe the conduct of any or all portions of the testing process.

B. All cables that fail testing are to be corrected prior to substantial completion and acceptance by owner. Replace entire cable if bad pair or conductor is found.

END OF SECTION 271500

SECTION 280010 - GENERAL REQUIREMENTS ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and to all following sections within Division 28.

1.2 SUMMARY

A. This Division requires providing complete and functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities to accomplish the following general scope:

1. Provide a complete and functioning Electronic Safety and Security System (ESSS). The ESSS is made up of multiple subsystems including a telephone based Intercom System, Video Surveillance System and an Access Control System.

B. Division 28 of these Specifications, and Drawings numbered with prefixes T, generally describe these systems, but the scope of the Electronic Safety And Security System Work includes all such Work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing, Electrical,
Telecommunications and Electronic Safety And Security System Drawings and Specifications; and Addenda.

C. Drawings are graphic representations of the Work upon which the Contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of Work, indicating the intended general arrangement of the equipment, fixtures, outlets and cabling without showing all of the exact details as to elevations, offsets, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

1.3 ABBREVIATIONS

A.	ADA	Americans with Disabilities Act
B.	AFF	Above Finished Floor
C.	ANSI	American National Standards Institute
D.	ASTM	American Society for Testing and Materials
E.	BICSI	Building Industry Consulting Service International
F.	CCTV	Closed Circuit Television
G.	CPU	Central Processing Unit (computer)
H.	EIA	Electronic Industries Alliance
I.	ETL	Electrical Testing Laboratories, Inc.
J.	ESN	Electronic Security Network
K.	ESSC	Electronic Safety and Security Contractor
L.	ESSS	Electronic Safety and Security System
M.	FCC	Federal Communications Commission
N.	FM	Factory Mutual
O.	IEEE	Institute of Electrical and Electronic Engineers
P.	LED	Light Emitting Diode
Q.	NEC	National Electric Code
R.	NESC	National Electrical Safety Code
S.	NEMA	National Electrical Manufacturers Association
T.	NFPA	National Fire Protection Association
U.	NJATC	National Joint Apprenticeship and Training Committee
V.	NRTL	Nationally Recognized Testing Laboratory

W. OEM Original Equipment Manufacturer

X. OSHA Occupational Safety and Health Administration

Y. OSP OutSide Plant

Z. RCDD® Registered Communications Distribution Designer

AA. UL Underwriters Laboratories

BB. UON Unless Otherwise Noted

1.4 DEFINITIONS:

A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:

1. Furnish: “To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations.”
2. Install: “To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use.”
3. Provide: “To furnish and install complete, and ready for the intended use.”
4. Furnished by Owner (or Owner-Furnished) or Furnished by Others: “An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.

5. Engineer: Where referenced in this Division, “Engineer” is the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Design Professional, in addition to involvement by, and obligations to, the “Architect”.
6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTL’s that are acceptable to the AHJ, and standards that meet the specified criteria.
8. AS DIRECTED means as directed by the Architect, or his representative.

9. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, or installed within suspended ceilings.
10. SUBMIT means submit to Architect for review.
11. WET LOCATION means a pathway that does not protect cables from moisture levels that are beyond the intended operating range of “inside” premises cable.

    a. For example: Slab-on-grade construction where pathways are installed underground or in concrete slabs that are in direct contact with soil (e.g., sand and gravel) is considered a “wet location.”
    b. Also refer to the:

        1) NEC, Article 100 for definitions of Location, Damp; Location, Dry; and Location, Wet.
        2) Telecommunications Distribution Methods Manual (TDMM) for definitions of Wet locations.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”.

C. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

1.5 CODES, REFERENCES, AND STANDARDS

A. The references to the following codes, references and standards are meant to represent the most current and up-to-date revisions or printing as of the issue of this document. The Contractor is responsible for following the correct revision or printing (UON).

B. Execute all Work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of Work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Architect’s and Engineer’s attention in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.

C. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Architect and Engineer, without additional compensation. Contractor will be held responsible for any violation of the law.

D. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.

E. All material, manufacturing methods, handling, dimensions, methods of installation and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them:

1. NFPA 70 – National Electrical Code (NEC)
2. NFPA 730 – Guide for Premises Security
3. NFPA 731 – Installation of Electronic Premises Security Systems
4. NFPA 101 – Life Safety Code
5. National Electrical Safety Code (NESC)

1.6 GUIDELINES

A. NFPA 730 – Guide for Premises Security

B. BICSI Electronic Safety And Security Design Reference Manual (ESSDRM)

C. ANSI/TIA/EIA-568 – “Commercial Building Telecommunications Cabling Standard”

D. ANSI/TIA/EIA-569 – “Commercial Building Standard for Telecommunications Pathways and Spaces”

E. TIA/EIA-526-7 – “Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant”

F. TIA/EIA TSB 140 – “Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems”

1.7 QUALITY ASSURANCE

A. Execute all Work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the Work specified. Contract documents make use of the term Electronic Safety and Security Contractor (ESSC) to describe typical project responsibilities with respect to field work, however the documents make no assignment of said duties.

B. ESSC shall be a certified installer by the equipment manufacturers whose products shall be incorporated into this project. Post-bid certification will not be accepted.

C. ESSC shall maintain certification by the manufacturers thru the duration of the warrantee period.

D. Submit information supporting compliance with the following minimum requirements substantiating ESSC's qualification to bid this project:

1. Minimum five (5) continuous years in the business of integrating and/or installing Electronic Safety and Security Systems incorporating systems and equipment including but not limited to video surveillance systems.
2. Personnel Qualifications; submit information supporting compliance with the following minimum requirements:

a. For Project Manager; possess one or more of the following:

1) A Level III Video Security Systems Technician certification by National Institute for Certification in Engineering Technologies (NICET) and be in good standing.
2) BICSI certified RCDD.
3) Technology related degree from an ABET accredited institution.

b. Additionally, Project Manager must be certified as an installer by each manufacturer whose equipment is being installed on the project.
c. Installer Technicians shall be in good standing as at least one of the following (if not also serving as Project Manager):

1) Certified as an Installer Technician by the NJATC with at least 5 years of experience.
2) A BICSI Certified Level 1 Commercial Installer.
3) A NICET level III technician (audio, automation, or video).
4) NBFAA.
5) Or be assigned to work under the direct supervision and direction of a person holding said certifications.

d. These requirements are provided as a minimum level for qualification. Any additional or more stringent requirements imposed by a manufacturer of equipment installed for this project shall be met to achieve the term of warranty as specified in this division.
e. State Certifications combined with manufacturers' certifications shall additionally satisfy Personnel Qualifications.
f. Alternate qualifications may be considered if requested alternates are provided in accordance with the substitution section herein.

E. Install all Work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements in which case these documents shall govern. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with BICSI guidelines.

F. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer. Manufacturer's nameplate or logo shall not be a predominate feature of installed field device's finished appearance.

G. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and proven at other facilities, used without modification, renovation, or repair, for not less than one year prior to date of bidding for this Project.

H. Comply with the current applicable codes, ordinances, and regulations of the authority or authorities having jurisdiction, the rules, regulations and requirements of the service providers serving the project and the Owner's insurance underwriter.

I. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ the more stringent, as determined by the engineer, shall apply.

J. Should any change in drawings or specifications be required to comply with governing regulations, notify and receive written approval from the Architect prior to submitting bid.

K. All equipment and installations shall meet or exceed minimum requirements of ADA, ANSI, ASTM, IEEE, NEC, NEMA, NFPA, OSHA, UL, and the State Fire Marshall.

L. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workmanlike manner by competent workmen. Provide a competent, experienced, full-time Project Manager who is authorized to make cost, scope, and schedule decisions on behalf of the Contractor.

M. Provide a minimum of 4 hours of installation refresher training to all installers, delivered by the manufacturer or manufacturer's representatives, within 2 weeks prior to the project start date.

1.8 WORK INCLUDED

A. Provide labor, materials, and accessories required to provide complete, operating Electronic Safety and Security Systems. Labor, materials or accessories not specifically called for in the Contract Documents, but required to provide complete, operating systems shall be provided without additional cost to the Owner. The work includes, but is not necessarily limited to, the following subsystems and integration thereof:

1. Video Surveillance
2. Access Control
3. Intercom

B. Provide labor and materials required to install, test, and place into operation the Electronic Safety And Security Systems infrastructure as called for in the Contract Documents, and in accordance with applicable codes and regulations. Labor, materials or accessories not specifically called for in the Contract Documents, but required to provide complete, operating infrastructure shall be provided without additional cost to the Owner. The work includes, but is not necessarily limited to, the following

1. All conduit, raceways, back boxes, equipment room pathways, and cabling between the Electronic Safety And Security headend equipment and field devices.

2. Where tray rated plenum cable is installed in equipment rooms without conduit, all physical cable management hardware including, but not limited to: "J-hooks" in accessible ceiling areas, cable trays, conduits, ladder-type cable racks within telecommunication rooms and "D-rings" on backboards and equipment racks/cabinets/frames.
3. Seismic bracing of all cabinets, equipment racks and ladder-type cable racks provided under this work as required by code and by local governing jurisdiction.
4. Testing, labeling and documentation of all cables and hardware installed under this contract.
5. Preparation and submission of shop drawings, testing reports, as-built drawings, and cabling documentation as described below.
6. Fire stopping as required.

1.9 COORDINATION

A. Coordinate with other Divisions for Electronic Safety And Security work to be performed.

B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any Work covered by this Division.

C. Refer to Electronic Safety And Security Drawings and Divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide all offsets, fittings, and accessories, required to clear equipment, beams, and other structural members which may be required but not shown on the Drawings.

D. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. Maintain a project manager, as specified by the Quality Assurance section of these specifications, on the jobsite at all times to coordinate this Work with other trades so that various components of the Electronic Safety And Security systems are installed at the proper time, fits the available space, allows proper service access to all equipment, and meets all required codes and standards.

F. Execute the work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.

G. Work of this Division shall progress according to the "Construction Schedule" as described in Division 1 and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.

H. The locations of devices, equipment racks, and other equipment indicated on the Contract Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in order to meet field conditions, or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

I. Exercise particular caution with reference to the location of devices, control stations, switches, etc., and have precise and definite locations accepted by the Architect before proceeding with the installation.

J. The Contract Drawings may show only some of the general runs of raceway and approximate locations of devices and outlets. Any significant changes in location necessary in order to meet field conditions shall be brought to the immediate attention of the Architect for review before such alterations are made. Modifications shall be made at no additional cost to the Owner.

K. Verify with the Architect the exact location and mounting height of devices, outlets, and equipment not dimensionally located on the Drawings.

L. The drawings generally do not indicate the number of cables in conduit, or the actual identity of cables in specific conduits, cable tray or other cabling pathways. Under no circumstances shall NEC raceway percent fill requirements be exceeded, regardless of the type of cabling installed or load served. Provide the correct cable type and quantity as required by the indicated devices, cable schedules, the design intent of any example drawings or schedules, referenced wiring diagrams (if any), the maximum distance limitations, and the applicable requirements of the NEC and ANSI/TIA/EIA-568.

M. All cabling shall be installed complete and unspliced from field device termination to headend termination.

N. Carefully check space requirements with other trades to insure that equipment can be installed in the spaces allotted.

O. Wherever work interconnects with work of other trades, coordinate with other trades to insure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (Cable Trays, Fire stopping systems, pull boxes, etc.) requiring access in order that the Ceiling Trade will know where to install access doors and panels.

P. Furnish and set sleeves for passage of Electronic Safety And Security risers through structural masonry and concrete walls as required for the proper protection of each Electronic Safety And Security riser passing through building surfaces.

Q. Provide fire stopping around all conduits, cable trays, sleeves, etc. which pass through rated walls and partitions. Where the rating of a wall or partition is unknown, treat as though it were fire and temperature rated.

R. Provide fire stopping around all cables within conduits, cable trays, sleeves, etc. as required in accordance with the specific fire stop system(s) being installed.

S. Provide detailed information on openings and holes required in pre-cast members for Electronic Safety And Security work.

T. Provide required supports and hangers for conduit and equipment, designed so as not to exceed allowable loadings of structures. Use only listed devices where available.

U. Examine and compare the Contract Drawings and Specifications with the Drawings and specifications of other trades, and report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

V. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit these drawings to the Architect for review. At completion include a set of these drawings with each set of Record Drawings.

W. Furnish services of an experienced Project Manager as required by these specifications, who shall be in constant charge of all work, and who shall coordinate work with the work of other trades. No work shall be installed before coordinating with other trades.

X. Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

Y. Adjust location of conduits, terminal blocks, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication.

1. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.

Z. In cases of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Architect.

1.10 MEASUREMENTS AND LAYOUTS

A. The Drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

1.11 SUBMITTALS

A. Refer to Division 1 and General Conditions for submittal requirements.

B. Supplemental to Division 1 requirements submit no fewer than 6 copies of the following documents to indicate the required personnel qualifications per the quality assurance section of this section:

1. Certifications of ESSC.
2. On-site project manager

    a. A copy of the Certified Technician certificate and member number must be provided with bidding documents.

3. Other personnel physically installing any portion of the Electronic Safety And Security system:

    a. A copy of Installer certification(s) as issued with the person's name and certificate number and logos.
    b. A document provided by the manufacturer describing what specific subjects the certification covers, period of time spent doing course work required to gain certification, exam topics, and the requirements needed to maintain the certification.

C. For all warranties required under this division and supplemental to Division 1 requirements submit no fewer than 6 copies of the following documents to indicate the required warranty terms and coverage's:

1. Warranty terms and conditions must contain the following:

    a. Length of warranty period
    b. Applications covered (future and present)
    c. Single manufacturer responsible for fulfilling warranty
    d. Who is covered
    e. What is covered
    f. All disclaimers, limitations, etc.
    g. What, if anything, is not covered

D. Assemble and submit for review, manufacturers' product literature for material and equipment to be furnished, installed, or both, under this Division, including shop drawings, manufacturers' product data and performance sheets, samples, and other submittals required by this Division. Provide the number of submittals required by Division 1; however, at a minimum, 6 sets.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept.

F. Refer to individual Sections of these Specifications for any additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow for two weeks Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information. Submittals not so identified will be returned to the Contractor without action:

    1. The project name.
    2. The applicable Specification Section and paragraph.
    3. The submittal date.
    4. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
    5. Where multiple part numbers and/or descriptions are on a single page, identify the material intended for use in this project.

J. The Engineer's checking and subsequent acceptance of such submittals shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Engineer's and Architect's attention to such deviations at the time of submission, and secured written acceptance; nor

shall it relieve him from responsibility for errors in dimensions, details, sizes of members, or quantities; or for omissions of components or fittings; or for not coordinating items with actual building conditions and adjacent work.

1.12 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings, Contractor may, at his option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for a set of more than 12 sheets. Contact the Architect for Architect's written authorization. Complete and send the form attached at the end of this section along with a check made payable to Henderson Engineers, Inc. Indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.13 SUBSTITUTIONS

A. Refer to Bid documents, General and Supplementary Conditions and Division 1 Specification Sections for limitations and restrictions on substitutions.

B. Materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. No substitutions will be considered with receipt of Bids, unless the Architect and Engineer have received from the Bidder a written request for approval to bid a substitution at least ten calendar days prior to the date for receipt of Bids, and have approved the substitution request. Include, with each such request, the name of the material or equipment for which substitution is being requested, and a complete description of the proposed substitution, including drawings, cut sheets, performance and test data, and all other information necessary for an evaluation. Include also a statement setting forth changes in other materials, equipment or other work that would be required to incorporate the substitution. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's or Engineer's decision to approve or disapprove a substitution in a Bid is final.

D. Indicate revisions required to adapt substitutions including revisions by other trades. Substitutions that increase the cost of the work and related trades are not permitted.

E. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner, including verbal. Acceptance of substitute equipment manufacturers does not relieve Contractor of the responsibility to provide equipment and materials, which meet the performance as stated or implied in the Contract Documents.

F. No substitutions will be considered after receipt of Bids and before award of the Contract.

G. No substitutions will be considered after the Contract is awarded unless specifically provided for in the Contract Documents.

H. Proposals for substitutions shall include the following information:

1. A description of the difference between the Contract Document requirements and that of the substitution, the comparative features of each, and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of additional costs to the other trades.
2. Schematic drawings and details.
3. List of revisions to the Contract Documents that must be made if the substitution is accepted.
4. Estimate of costs the Owner may incur in implementing the substitution, such as test, evaluation, operating and support costs.
5. Statement of the time by which a Contract modification accepting the substitution must be issued, noting any effect on the Contract completion time or the delivery schedule.
6. A statement indicating the reduction to the Contract price if the Owner accepts the substitution. Include required modifications to all related trades.
7. Alternate contractor/installer/personnel qualification requirements for submittals.

1.14 OPERATION AND MAINTENANCE DATA

A. Refer to Division 1 and General Conditions for Operation and Maintenance Data.

B. Submit data prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish for Engineer’s review, and for the Owner’s use, four (4) copies of Operation and Maintenance manuals in three-ring, loose-leaf, hard-back notebook form, divided and tabbed, containing;

1. Theory of Operation for the integrated system
2. Theory of Operation for each sub-system
3. Equipment data for materials comprising each sub-system, tabbed per sub-system.
4. Approved submittals
5. Shop drawings
6. Point-to-point wiring diagrams
7. Capacities

8. List of spare parts and part numbers recommended for normal service inventory requirements
9. Test reports.
10. Manufacturer's service and maintenance data
11. Maintenance Schedule for each piece of serviceable equipment, grouped by sub-system. Include cleaning, testing, and adjustment data.
12. Trouble shooting diagnostic instructions.
13. Warranties
14. Guarantees
15. Nearest available source, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Electronic Documentation

1. In addition to the printed manuals, provide electronic version in .pdf format, written to CDs or DVDs.
2. Provide interactive .pdf or similar graphical maps of the facility with hyperlinked icons representing locations of installed Electronic Safety and Security equipment, including field devices and headend equipment. Hyperlink icon shall link to area enlarged maps (where needed) or equipment breakouts or, when at the highest level of map resolution, hyperlinked icons shall link to equipment data sheets specific to the device(s) represented and complete system location information such as device termination and cable ID information as well as headend termination location.

F. Substantial Completion of the project

1. Furnish for the Owner's use, revised (if needed) hard copy and electronic forms of Operation and Maintenance manuals submitted prior to Substantial Completion addressing comments made therein. Update Electronic Documentation as well.

1.15 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections of this Division.

B. Obtain the Owner's or Owner's representative's initials and date on each delivery invoice when the specified spare parts are delivered; and, obtain the Owner's or Owner's representative's signature on delivery summary sheet when all spare parts have been received.

1.16 RECORD DRAWINGS

A. Keep a set of jobsite work prints of the Issued for Construction Drawings on the jobsite during construction, for the purpose of annotating changes. During the course of

construction, indicate on these Documents, changes made from the Conformed Contract Documents. Pay particular attention to those items that require locating for servicing.

B. Refer to Division 1 and General Conditions for Record Drawings

C. At the completion of the project, obtain reproducible bond copies of the final Drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Mark each sheet "Record Drawing", along with the date, and deliver these Record Drawings to the Architect.

1.17 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling.

B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect and Engineer.

D. Be responsible for the safe storage of tools, material and equipment.

1.18 WARRANTIES

A. Refer to Division 1 and General Conditions for Warranties.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

C. Warrant each sub-system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are required to carry a longer warranty in these Construction Documents or manufacturer’s standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 1.

D. The warranty shall include labor and material. Make repairs or replacements without any additional costs to the Owner.

E. Perform the remedial work promptly, upon written or electronic notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.19 PROJECT CONDITIONS

A. The following project conditions apply:

1. The Drawings describe the general nature of and extent of work involved.

B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Use only products listed for their intended use by a NRTL, except products for which no relevant standards exist.

B. Where products are required to be NRTL listed, classified, approved or otherwise each individual item shall bear the NRTL mark by permanent means.

C. Provide products and materials that are new, clean, free of defects, and free of damage and corrosion.

D. Products and materials shall not contain asbestos, PCB, or any other material, which is considered hazardous by the Department of Environmental Protection or any other authority having jurisdiction.

E. Replace materials of less than specified quality and relocate work incorrectly installed as directed by the Architect.

F. Provide name/data plates on major components of equipment with manufacturer's name, model number, serial number, capacity data and electrical characteristics attached in a conspicuous place.

G. Install materials and equipment with qualified trade people.

H. Maintain uniformity of manufacturer for equipment used in similar applications and sizes.

I. Follow manufacturer's instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.

J. Where factory testing of equipment is required to ascertain performance and attendance by the Owner's representative is required to witness such tests, associated travel costs and subsistence shall be paid for by the Contractor.

K. Equipment capacities, ratings, etc., are scheduled or specified for job site operating conditions. Equipment sensitive to altitude shall be de-rated with the method of de-rating identified on the submittals.

L. Enclosures for Electronic Safety And Security Infrastructure equipment installed in mechanical equipment rooms shall be NEMA type 1 gasketed. Enclosures for Electronic Safety And Security Infrastructure equipment installed outdoors shall be NEMA type 3R.

M. Conduit:

1. All field wiring not in plenum spaces shall be in conduit.

    a. Electrical metallic tubing (EMT) with compression connectors shall be used where concealed in walls, above ceilings, and exposed or concealed in equipment rooms.
    b. Rigid galvanized conduit shall be used where exposed conduit is required in areas 15 feet or less above finished floors and may be used where EMT is approved. Exposed conduit in areas shall be anchored to walls or ceilings with two-hole straps on no less than 48 inch centers using threaded couplings, support in all other locations shall be per the National Electrical Code or better. All joints shall be by threaded connection.
    c. Use of flexible conduit shall not be used in lieu of conduit bends.

N. If products and materials are specified or indicated on the drawings for a specific item or system, use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of product data submittal.

O. Ship and store all products and materials in a manner that will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain a replacement. Repairs of damaged goods will only be permitted with prior written permission of the Owner/Engineer.

P. Part numbers and product codes in these specifications are correct as of the time of writing. Manufacturers may, however, change part numbers and product codes on short notice. In cases where part numbers or product codes differ from technical specifications for a particular product, provide products meeting the minimum technical specifications of the products in the specifications. Notify the

Owner/Engineer of any product code and or part number changes on the material list submittal.

Q. Product Consistency: Any given item of equipment or material shall be the product of one manufacturer throughout the facility. Multiple manufacturers of any one item will not be permitted, unless specifically noted otherwise.

2.2 SURGE AND TAMPER PROTECTION

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

1. Northern Technologies
2. Transtector Systems, Inc.
3. DiTek

B. Surge Protection: Protect components from voltage surges originating external to equipment housings and entering through power, communication, signal, control, and sensing leads. Provide surge protection for each circuit of power wiring and for all other conductors entering or leaving the building confines and for devices residing above the roof level.

1. Minimum Protection for AC Power Circuits 120 V and More: Multistage surge suppressors, listed under UL 1449, using a combination of inductors and silicon avalanche diodes or equivalent, and with 300-V suppression level and 5-nanosecond maximum response time.

    a. Silicon Avalanche Diodes: Bipolar, Grade A, plus or minus 5 percent tolerance.
    b. Discrete TVSS Units External to Protected Equipment: Enclosed modules with indicating lights labeled "power on" and "failure." Units shall have remote monitoring contacts connected to the Access Control system for annunciation of failure on the control station having monitoring responsibility.

2. Minimum Protection for Communication, Signal, Data, Control, and Low-Voltage Power Circuits: Silicon avalanche diode, -type arresters rated 90 V at 5000 A, or optical isolation, or as recommended by equipment manufacturer.

C. Tamper Protection: Tamper switches are required on all enclosures, racks, control units, cabinets, and other system components. Tamper switches shall initiate a tamper-alarm signal when the unit is opened or partially disassembled. Control station touchscreen display shall identify tamper alarms and indicate locations.

PART 3 - EXECUTION

3.1 FEES AND PERMITS

A. Secure and Pay all required fees and obtain all required permits related to the Electronic Safety And Security system and infrastructure installation. Arrange with the various service provider companies for the installation and connection of all required services to this facility and pay all charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

B. Pay royalties or fees in connection with the use of patented devices and systems.

3.2 SUBMITTALS AND REVIEWS

A. Submit shop drawings, manufacturer's product data sheets, samples, and test reports as specified.

1. Shop Drawings: See sub-paragraph N, below.
2. Samples as requested shall be physical examples that represent materials, equipment or workmanship and establish standards by which the work will be judged. Samples will not be returned to the Contractor.
3. Test Reports:

a. Pre-Installation Testing Reports: Submit two sets of manufacturers' or field-testing reports for those materials identified in the individual system Specification Sections as requiring that such reports be submitted.
b. Post-Installation Testing Reports: See See Specification Sections in Division 28

B. Within two weeks after notice to proceed by the Owner or Owner's Representative, or after execution of Owner/Contractor Agreement, submit a complete typed list of all Electronic Safety And Security equipment manufacturers and material suppliers for the equipment proposed to be provided on this project, as well as names of all subcontractors.

C. Within two weeks after notice to proceed by the Owner or Owner's Representative, or after execution of Owner/Contractor Agreement, prepare an index of all submittals for the project. Include a submittal identification number, a cross-reference to the Specification sections or Drawing number, and an item description. Prefix the submittal identification number by the Specification sections to which they apply. Indicate on each submittal, the submittal identification number in addition to the other data specified. All subcontractors shall utilize the assigned submittal identification number.

D. After the Contract is awarded, obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all

materials and equipment as specified. Submit data and details of such materials and equipment for review. Prior to submission, certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Check all materials and equipment upon their arrival on the job site and verify their compliance with the Contract Documents. Modify any work, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

E. Review of submittals is for general compliance with the design concept and Contract Documents. Comments or absence of comments shall not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing the work in a safe manner, and for coordinating the work with that of other trades.

F. No part of the work shall be started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted and accepted.

G. A minimum period of ten working days, exclusive of transmittal time, will be required in the Engineer's office each time a shop drawing, product data and/or samples are submitted for review. This time period must be considered by the Contractor in the scheduling of the work.

H. Submit 6 bond prints of all items requiring shop drawings. Submit 6 copies of manufacturer's product submittals.

I. Submit materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalog material. Maintenance and operating manuals are not acceptable substitutes for shop drawings.

J. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as materials or paint finish.

K. Include dimensional data for roughing in and installation and technical data sufficient to verify that equipment meets the requirements of the Contract Documents. Include wiring, piping and service connection data.

L. Maintain a complete set of reviewed and stamped shop drawings and product data on site.

M. For each room or area of the building containing Electronic Safety And Security Infrastructure equipment, submit the following:

1. Floor plans, at not less than 1/8" scale, showing security device locations, routing of Electronic Safety And Security conduits larger than trade size 1-1/4", cable trays and wireways, including surface-mounted raceways. Also show the routing of bundles of cables supported by "J-hooks", or similar means, if and

where such installation practices are allowed by the Contract Documents such as within equipment rooms.

2. Riser diagrams showing types, quantities and schematic routing of all Electronic Safety And Security backbone pathways, and cabling.
3. Enlarged plan views and elevation layout drawings for the Electronic Safety And Security Entrance Facility Room, Electronic Safety And Security Rooms and all other designated Electronic Safety And Security Equipment Rooms indicating the equipment in the exact location in which it is intended to be installed. These plans shall be of a scale not less than ¼ inch = 1'-0". They shall be prepared in the following manner:

    a. Indicate the physical boundaries of the space including door swings and ceiling heights and ceiling types (as applicable).
    b. Illustrate all Electronic Safety And Security equipment proposed to be contained therein. Include top and bottom elevations of all Electronic Safety And Security equipment. The Drawings shall be prepared utilizing the dimensions contained in the individual equipment submittals. Indicate code and manufacturer's required clearances.
    c. Illustrate all other equipment therein such as conduits, detectors, lighting fixtures, ducts, registers, pull boxes, wireways, structural elements, etc.
    d. Indicate the operating weight of each piece of equipment.
    e. Illustrate concrete pads, curbs, etc.
    f. Indicate dimensions to confirm compliance with code-required clearances.
    g. Indicate maximum normal allowable operating temperature for each piece of equipment (as per each respective manufacturer's recommendation). (Note: This requirement applies to active Electronic Safety And Security equipment such as LAN hubs, routers, amplifiers, radio transmitters/receivers, PBX or key telephone equipment, etc., if installed under this work.)
    h. Equipment removal routes for individual equipment items with plan dimensions exceeding 24" by 36" or height exceeding 84".

N. The work described in shop drawing submissions shall be carefully checked by all trades for clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and coordination with other trades on the job. Each submitted shop drawing shall include a certification that related job conditions have been checked by the Contractor and each Subcontractor and that conflicts do not exist.

O. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions, or for deviations from the requirements of the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superseded in any way by the review of shop drawings, product data and samples.

P. Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.

Q. Indicate the following on the lower right hand corner of each shop drawing and on the front cover of each product data brochure cover: The submittal identification number; title of the sheet or brochure; name and location of the project; names of the Architect, Engineer, Contractor, Subcontractor, manufacturer, supplier, and vendor; the date of submittal; and the date of each correction, version and revision. Number all pages and drawings in product data brochures consecutively from beginning to end. Unless the above information is included, the submittal will be returned for re-submission. Resubmittals of product data or brochures shall include a cover letter summarizing the corrections made in response to the review comments.

R. The Electronic Safety And Security room layout submittals and the related Electronic Safety And Security equipment submittals shall be submitted concurrently. Failure to submit concurrently may result in the immediate return of the submittal marked REVISE AND RESUBMIT.

3.3 EXAMINATION OF SITE

A. Prior to the submitting of bids, visit the project site and become familiar with all conditions affecting the proposed installation and make provisions as to the cost thereof.

B. The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical, electrical and Electronic Safety And Security installations, above or below ground, or other sub-surface conditions which may be encountered during the work. Evaluate existing conditions, which may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for satisfactory completion of the work.

3.4 ACCESS TO EQUIPMENT

A. Locate all pull boxes, junction boxes and fire stopping systems so as to provide easy access for operation, service inspection, and maintenance. Provide an access door where equipment or devices are located above inaccessible ceilings.

B. Maintain all code required clearances and clearances required by manufacturers.

3.5 CUTTING AND PATCHING

A. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, layout the work carefully in advance. Repair any damage

to the building, piping, equipment or defaced finished plaster, woodwork, metalwork, etc. using skilled tradespeople of the trades required at no additional cost to the Owner.

B. Do not cut, channel, chase or drill masonry, tile, etc., unless permission from the Architect is obtained. If permission is granted, perform this work in a manner acceptable to the Architect.

C. Patch around all openings to match adjacent construction.

D. Where conduit or equipment is mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.

E. Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.

F. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.6 MOUNTING HEIGHTS

A. Mounting heights shall conform to ADA requirements.

B. Mounting heights shall be from floor to center of device, unless otherwise noted. Verify exact locations and mounting heights with the Architect before installation.

C. Unless otherwise noted, wall mounted devices requiring operational access shall be mounted 48 inches above finished floor to highest operable portion of device.

3.7 PAINTING

A. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer's instructions for pre-cleaning surfaces and application.

B. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.

C. Where factory finishes are provided and no additional field painting is specified, touch-up or refinish, as required by, and to the acceptance of, the Architect and Engineer, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Architect or Engineer, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

D. Provide touch-up paint as required by Specification Sections in this Division.

3.8 CLEANING

A. Avoid accumulation of debris, boxes, loose materials, crates, etc., resulting from the installation of this work. Remove from the premises each day all debris, boxes, etc., and keep the premises clean and free of dust and debris.

B. Immediately prior to final inspection, make a final cleanup of dirt and refuse resulting from Work and assist in making the premises vacuum clean. Clean all material and equipment installed under this Division.

C. Clean all fixtures and equipment at the completion of the project. Wipe clean exposed lighting fixture reflectors and trim pieces with a non-abrasive cloth just prior to occupancy.

D. Remove dirt, dust, plaster, stains, and foreign matter from all surfaces.

E. Touch up and restore damaged finishes to their original condition.

F. All Electronic Safety And Security equipment shall be thoroughly vacuumed and wiped clean prior to energization and at the completion of the project. Equipment shall be opened for observation by the Architect as required.

3.9 WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.

B. Restore waterproofing integrity of walls or surfaces after they have been penetrated with appropriate 30yr materials without additional cost to the Owner.

3.10 SUPPORTS

A. Support work in accordance with the best industry practice. Provide supports, hangers, auxiliary structural members and supplemental hardware required for support of the work.

B. Provide supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in Electronic Safety And Security rooms and equipment rooms.

C. Provide supporting frames or racks for equipment, which is installed in a freestanding position.

D. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

E. Adequate support of equipment (including outlet, pull and junction boxes and fittings) shall not depend on electric conduits, raceways, or cables for support.

F. Electronic Safety And Security equipment shall not rest on or depend for support on suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Provide independent support of Electronic Safety And Security equipment. Do not attach to supports provided for ductwork, piping or work of other trades.

G. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure. Electronic Safety And Security equipment and supports shall not come in contact with work of other trades.

3.11 FASTENINGS

A. Fasten equipment to building structure in accordance with the best industry practice and as indicated in subsequent paragraphs.

B. Where weight applied to the attachment points is 100 pounds or less, conform to the following as a minimum:

1. Wood: Wood screws.
2. Concrete and solid masonry: Bolts and expansion shields; self-tapping concrete screws shall not be used.
3. Hollow construction: Toggle bolts.
4. Solid metal: Machine screws in tapped holes or with welded studs.
5. Steel decking or sub-floor: Fastenings as specified below for applied weights in excess of 100 pounds.

C. Where weight applied to building attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following as a minimum:

1. At concrete slabs provide 24 inch x 24 inch x ½ inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top of slab screed line, where no fill is to be applied.
2. At steel decking or sub-floor for all fastenings, provide through bolts or threaded rods. The tops of bolts or rods shall be set at least one inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with his decking or sub-floor such hangers shall be provided.

D. Where weight applied to building attachment points exceeds 300 pounds, coordinate with and obtain the approval of Architect and conform to the following as a minimum:

1. Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.

E. For items, which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.

F. Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars. Prefabricated steel channels as manufactured by Kindorf or Unistrut are acceptable.

G. Except in equipment rooms, all exposed securing screws shall be stainless steel, center pin torx security screws. Security Fasteners: A maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

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

a. Holo-Krome; a Danaher Corporation.
b. Safety Socket Screw Corporation.
c. Tamper-Pruf Screws, Inc.
d. Textron Inc.

3.12 IDENTIFICATION

A. See individual sections for any additional identification requirements.

B. The inclusion or installation of any equipment or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other source(s) from which such object has been obtained, is prohibited.

C. Required UL labels shall not be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

3.13 DELIVERY, DRAYAGE AND HAULING

A. Provide drayage, hauling, hoisting, shoring and placement in the building of equipment specified and be responsible for the timely delivery and installation of equipment as required by the construction schedule. If any item of equipment is

received prior to the time that it is required, provide proper storage and protection until the time it is required. Pay for all costs of demurrage or storage.

B. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, then Contractor shall be responsible for resulting disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc. at no additional cost to the Owner.

3.14 EQUIPMENT AND MATERIAL PROTECTION

A. Protect the work, equipment, and material of other trades from damage by work or workmen of this trade, and correct damaged caused without additional cost to the Owner.

B. Install equipment only in clean, dry, conditioned, and secured rooms.

C. Take responsibility for work, materials, and equipment until finally inspected, tested and accepted. Protect work against theft, injury, or damage, and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material. Cover and protect equipment and materials from damage due to water, spray-on fireproofing, construction debris, etc. Store equipment susceptible to moisture damage in dry, heated spaces.

D. Provide adequate means for fully protecting finished parts of materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair.

3.15 ADJUSTING, ALIGNING AND TESTING

A. Adjust, align and test all Electronic Safety And Security equipment furnished and/or installed under this Division.

B. Check and test protective devices for specified and required application, and adjust as required.

C. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.

D. Notify the Architect immediately of all operational failures caused by defective material, labor or both.

E. Refer to individual Sections for additional and specific requirements.

3.16 START-UP OF SYSTEMS

A. Prior to start-up of Electronic Safety And Security systems, check all components and devices, to confirm compliance with manufacturers' recommended installation procedures.

B. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.

3.17 TEST REPORTS FOR ELECTRONIC SAFETY AND SECURITY INFRASTRUCTURE SYSTEMS

A. Perform tests as required by these Specifications and submit the results. The tests shall establish the adequacy, quality, safety, and reliability for each Electronic Safety And Security system installed. See individual sections, particularly in Division 28, for extent of testing required. Notify the Architect and Engineer five working days prior to each test.

B. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and Contract closeout. Complete any adjustments and/or alterations, which the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date

C. For specific testing requirements of special systems, refer to the Specification section that describes that system.

D. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when field-testing will be performed. Submit completion schedule for review not later than 50% of project completion. Update this schedule periodically as the project progresses

E. Upon completing each test, record the results, date and time of each test and the conditions under which the test was conducted. Submit to the Architect, for Engineer's review, in duplicate. Supply all test results required by Division 28 specifications.

F. Promptly correct all failures or deficiencies revealed by these tests and as determined by the Engineer.

3.18 OPERATING INSTRUCTIONS

A. Provide the services of factory trained specialists to provide both an operating and a maintenance instruction seminar for equipment and systems. These seminars shall be conducted over at least a two-day (consecutive) period with operational instruction

occurring first. Instruction time is defined as straight time working hours and does not include nights, weekends, or travel time to and from the project.

B. Submit seminar agenda, schedule, and list of representatives to the Owner for approval thirty days prior to suggested date of seminar. Do not commence seminar until the Owner has issued a written acceptance of the starting time and list of attendees. Confirm attendance of seminar by written notification to participants.

C. Instruct Owner's operating personnel in proper starting sequences, operation, limitations, and shutdown.

D. Instruct Owner's maintenance personnel in general and preventative maintenance procedures, including normal and emergency procedures, trouble shooting, and replacement procedures for major system components.

E. Submit final copies of Record Drawings and Operating and Maintenance Manuals to Owner at seminar.

F. Provide video and audio recording of seminars. Index and edit recording to inject relevant graphics, examples, and additional commentary to produce a useful training video. Indexing shall be by topic and subsystem presented allowing viewer to select portion of training video they wish to review. Provide four copies of video in DVD format that can be played on consumer grade DVD players and PCs. Place no restrictions on Owner's rights to reproduce DVD for Owner's use.

G. Submit a written record of minutes and attendees of the seminar to the Owner.

3.19 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:

1. Perform start-up and tests and demonstration of all systems.
2. Remove all temporary facilities from the site.
3. Comply with all requirements for Substantial Completion in the Division 1 and General Conditions.

B. Request in writing a review for Substantial Completion. Give the Architect at least seven (7) days notice prior to the review.

C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect will either proceed with the review or advise the Contractor of unfilled requirements.

E. Provide a minimum of 2 technicians on-site for test and demonstration. Technicians shall be ready with all necessary tools, test equipment, and supplies necessary to

troubleshoot and correct system faults after testing is completed. System shall remain unaltered during testing.

F. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, then provide reimbursement to the Architect and Engineer for time and expenses incurred for the visit. If, upon system testing, it is determined by the Architect and Engineer that the system was not Substantially Complete, retesting shall be required at the Contractor's expense.

G. Upon completion of a successful Substantial Completion review, the Architect and Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

H. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

I. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

3.20 RECORD DRAWINGS

A. Maintain on a daily basis at the project site a complete set of Record Drawings, reflecting an accurate dimensional record of deviations between work shown on Drawings and that actually installed.

B. Record dimensions clearly and accurately to delineate the work as installed; suitably identify locations of all equipment by at least two dimensions to permanent structures. In addition, mark the Record Drawings to show the precise location of concealed work and equipment, including concealed or embedded raceways and cables and all changes and deviations in the Electronic Safety And Security Infrastructure work form that shown on the Contract Documents. This requirement shall not be constructed as authorization to make changes in the layout or work.

C. Upon completion of the installation obtain from the Architect, a complete set of bond drawings with professional's seal and firm name removed. In a neat and accurate manner, provide a complete record of all revisions of the original drawings, as actually installed. The cost for transparencies and for making required changes shall be included in the Contract. Submit one set of black line prints of these revised transparencies for review. After review, make necessary changes to transparencies and then deliver them to the Owner. The Record Drawings shall not be reviewed for accuracy nor will the Engineer assume any responsibility for accuracy of completeness.

D. Submit the as-built Electronic Safety And Security cabling schedules in three (3) final printed copies and on a CD or DVD as comma delimited ASCII format files (or other mutually acceptable media and format).

3.21 FINAL PUNCHLIST

A. Prior to the Final Punchlist, certify that systems and equipment are complete, operational, and are in compliance with the Contract Documents. Additionally, complete the following:

1. Submit complete Operation and Maintenance Data.
2. Submit complete Record Drawings.
3. Perform all required training of Owner's personnel.
4. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.

B. During the Final Punchlist, provide personnel with access keys, access card, hand held radios, and necessary expertise to operate each system and piece of equipment to demonstrate operational compliance with the Contract Documents. Provide a minimum of 2 technicians on-site for test and demonstration. Technicians shall be ready with all necessary tools, test equipment, and supplies necessary to troubleshoot and correct system faults after testing is completed. System shall remain unaltered during testing.

C. Any deficiencies noted on the Final Punchlist shall be expeditiously corrected and certified in writing.

3.22 EARLY OCCUPANCY

A. Complete those systems which are necessary to allow partial early occupancy of the new building.

B. Verify and comply with requirements for temporary occupancy with the local Building and Fire Departments.

3.23 ACCEPTANCE

A. Perform all tests required by Owner in addition to tests specified herein.

B. Provide a minimum of 2 technicians on-site for each test and demonstration. Technicians shall be ready with all necessary tools, test equipment, and supplies necessary to troubleshoot and correct system faults after testing is completed. System shall remain unaltered during testing.

C. Upon receipt of the Contractor's documentation of system testing, the Owner and Engineer will review/observe the installation and randomly request tests and demonstration of the system installed. Once all tests have been pass in accordance with sections in Division 28 and the Owner is satisfied that all work is in accordance with the Contract Documents, the Owner will notify the Contractor in writing that the work has been accepted.

3.24 SPECIAL TOOLS

A. Delivery to Owner's representative 2 complete sets of all special tools and small equipment items needed for proper operation, adjustment and maintenance of equipment installed under this work. All tools to be new and still in manufacturers' packaging. The cost for these tools is to be included within the bid price for this work.

B. The terms "special tools" and "small equipment items" is meant to include such items as punch down tools, connector assembly tools, security fastener drivers, etc. with each individual item having a retail replacement cost not exceeding five hundred dollars ($500.00). It is NOT meant to include common hand tools such as standard screwdrivers, pliers, wrenches, etc.

C. Submit the tool list along with the bid for this work. Include add/delete unit pricing for all tools on the list.

END OF SECTION 280010

AGREEMENT FOR TRANSFER OF INFORMATION
MACHINE-READABLE FORMAT

PROJECT NAME: PROJECT NO/PHASE: Made this day, _____

By and Between Henderson Engineers, Inc., Lenexa, Kansas (hereinafter referred to as ENGINEER) and (hereinafter referred to as RECIPIENT).

The enclosed electronic media are provided pursuant to your request for the purpose of production of shop drawings. In using it, modifying it, or accessing information from it, you are responsible for confirmation, accuracy, and checking of the data from the media. ENGINEER hereby disclaims any and all responsibility from any results obtained in use of this electronic media and does not guarantee any accuracy of the information.

RECIPIENT agrees that it shall not use the information provided by ENGINEER for any purpose other than that described above without the express written consent of ENGINEER. RECIPIENT also hereby acknowledges that the data delivered by ENGINEER is for use by RECIPIENT only, and is not to be released to any other party without the written consent of the ENGINEER and does not transfer ownership of the instruments of professional service.

RECIPIENT understands that the automated conversion of information and data from the system and format used by ENGINEER to an alternate system or format cannot be accomplished without the possibility of introduction of inexactitudes, anomalies, and errors. In the event project documentation provided to RECIPIENT in machine readable form is so converted, RECIPIENT agrees to assume all risk associated therewith, and to the fullest extent permitted by law, to hold harmless and indemnify ENGINEER from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising therefrom or in connection therewith.

RECIPIENT recognizes that changes or modifications to ENGINEER'S instruments of professional service introduced by anyone other than ENGINEER may result in adverse consequences that ENGINEER can neither predict nor control. Therefore, and in consideration of ENGINEER'S agreement to deliver its instruments of professional service in machine readable format, RECIPIENT agrees, to the fullest extent permitted by law to hold harmless and indemnify ENGINEER from and against all claim, liabilities, losses, damages, and costs, including misuse or reuse by others of the machine readable information and data provided by ENGINEER under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on another project, for additions to this project, or for completion of this project by others; ENGINEER may authorize excepting only such use in writing.

Send a check for shipping and handling costs in the amount of $200 for an electronic drawing set up to 12 sheets plus $15 per sheet in excess of 12 sheets payable to Henderson Engineers, Inc. along with completed and signed agreement and Architect's written authorization to receive electronic media. Be sure to indicate below the desired shipping method, format type and media type.

Signature
Henderson Engineers, Inc.
_____

Signature
_____

Date_____

Date _____

Shipping Method
E-Mail
☐ First Class Mail
☐ FedEx Overnight (No P.O.Boxes)

Format
☐ AutoCAD 2000/2002
☐ AutoCAD 2004/2005
☐ DXF

Media
☐ CD-ROM
☐ DVD

Shipping or E-Mail Address
_____
_____
_____
_____

Phone:
_____

SECTION 280015 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electronic safety and security equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

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

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

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

3. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
4. Pressure Plates: Plastic Carbon steel Stainless steel. Include two for each sealing element.
5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

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

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

A. Comply with NECA 1.

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

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

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

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

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

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

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

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

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

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

F. Extend sleeves installed in floors 2 inches above finished floor level.

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

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

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

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

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

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

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

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

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

3.4 FIRESTOPPING

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

END OF SECTION 280015

SECTION 280020 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. RS-232 cabling.
3. RS-485 cabling.
4. Low-voltage control cabling.
5. Control-circuit conductors.
6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. NRTL: Nationally Recognized Testing Laboratory.

E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Follow the requirements for submittals in Section 28 0010 – “General Requirements Electronic Safety and Security”.

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

1. Include the following installation data for each type used:

a. Nominal OD.
b. Minimum bending radius.
c. Maximum pulling tension.

C. Shop Drawings Cable layout showing conduit routes to scale. Include the following for each sub-system type (i.e. intercom, video , door control, access control, etc). Note that each system type requires a dedicated conduit system:

1. Conduit sizes, cables within, and percent fill.
2. Clearances for access above and to side of cable trays (permissible use in equipment rooms only with allowable cable types).
3. Vertical elevation of cable trays above the floor or bottom of ceiling structure if used.
4. Strain relief design/cable arrangement within racks.

D. Qualification Data: Per section 28 0010.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance Data: For wire and cable to include in maintenance manuals.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTPand connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling in Equipment Rooms: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." All wiring outside of equipment rooms shall be in raceways.

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

A. Backboards: Wall mounted plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

B. Backboards: Rack or cabinet mounted, 3/8” PVC or 14ga metal.

2.3 UTP CABLE

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

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. West Penn.
5. Mohawk; a division of Belden CDT.
6. Superior Essex Inc.

B. Description: 100-ohm, 4-pair UTP, with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-C.1 for performance specifications.
3. Comply with TIA/EIA-568-C.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG, CMR.
b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
c. Communications, Riser Rated: Type CMR, complying with UL 1666.
d. Communications, Limited Purpose: Type CMX.
e. Multipurpose: Type MPP or MPR.
f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
g. Multipurpose, Riser Rated: Type MPR complying with UL 1666.

2.4 UTP CABLE HARDWARE

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

1. Technology Systems Industries, Inc.
2. Hubbell Premise Wiring.
3. KRONE Incorporated.
4. Leviton Voice & Data Division.
5. Molex Premise Networks; a division of Molex, Inc.
6. Nordex/CDT; a subsidiary of Cable Design Technologies.
7. Panduit Corp.
8. Siemon Co. (The).
9. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

2.5 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.

5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.6 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.7 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.

5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.8 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway; CL2 power-limited cable, power-limited tray cable, in cable tray or raceway complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN-THWN, in raceway; CL3 power-limited cable, power-limited tray cable, in cable tray or raceway complying with UL 83.

2.9 IDENTIFICATION PRODUCTS

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

1. Brady Corporation
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. All cables, terminations, power supplies, relays, relay cards, and fuse/circuit breakers shall be labeled to match installation drawings.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables. Testing may be self-performed with certified equipment and personnel. Submit testing agency or certification data as preface to inspection report.

B. Factory test UTP cables according to TIA/EIA-568-C.2.

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

D. Prepare and submit test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in NEC for raceway and box sizing and installation.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room for conduits containing tray rated cable .
2. Install cable trays to route tray rated cables if layout permits. Other wiring shall remain in conduit.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches above finished floor or to terminating enclosure.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. All field wiring shall be in conduit from the headend equipment rooms to the terminating field device. Refer to Division 26 for raceway requirements.
2. Comply with TIA/EIA-568-C.1.
3. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
4. Install 110-style IDC termination hardware unless otherwise indicated.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.

6. Cables and conductors shall not be spliced or have intermediate terminations between field devices and headend equipment.
7. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before unreeling. Heat lamps shall not be used for heating.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-C.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Not permitted, except in equipment rooms with appropriately rated cable.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches .
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.3 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 12 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 14 AWG.

3.4 CONNECTIONS

A. Comply with requirements in Division 28 Section "Access Control" for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Division 28 Section "Intercom and Paging" for connecting, terminating, and identifying wires and cables.

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.

3.6 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Without exception, all labels shall be machined printed.

B. Identify system components, wiring, and cabling. Complying with TIA/EIA-606-A where applicable. Additionally, comply with requirements for special system conduit identification specified in Division 26 Section "Identification for Electrical Systems."

C. All cables, terminations, power supplies, relays, relay cards, and fuse/circuit breakers shall be labeled. All labels shall match final installation drawings.

D. Replace or relocate labels that cannot be read after termination, do not double label wiring at termination points.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare and submit test and inspection reports.

END OF SECTION 280513

SECTION 281116 - CABINETS, RACKS, AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions, requirements, and recommendations in Section 280010 – “General Requirements Electronic Safety and Security”.

1.2 SUMMARY

A. The work covered by this section of the Specifications includes all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work of this section shall include, but is not limited to, the following:

1. Fixed equipment racks and cabinets complete with all necessary installation hardware.

1.3 CODES, REFERENCES, AND STANDARDS

A. Follow all applicable codes, references, and standards listed in Section 280010 – “General Requirements Electronic Safety and Security”.

B. All racks and cabinets shall meet the requirements of EIA/ECA-310-E “Cabinets, Racks, Panels, and Associated Equipment “

1.4 QUALITY ASSURANCE

A. All equipment racks, cabinets and frames shall be listed by a NRTL

B. Installers shall meet the requirements for personnel as specified in the Quality Assurance Section of 280010 – “General Requirements Electronic Safety and Security”.

1.5 SUBMITTALS

A. Follow the requirements for submittals in Section 280010 – "General Requirements Electronic Safety and Security".

B. Product Data:

1. Submit the complete list of materials proposed for this work in accordance with Specification Section 280010 – "General Requirements Electronic Safety and Security".

C. Shop Drawings:

1. Shop Drawings

a. Shall show the position of the equipment racks and cabinets. Racks and cabinets shall be dimensioned and the position of the rack or cabinet shall be dimensioned from (2) walls in each Electronic Security equipment room.
b. Shop drawings for equipment racks and cabinets shall also show the detailed method of attachment to the floor and to any overhead ladder rack. All power strips and cable management raceways for equipment racks and cabinets shall be shown on the shop drawings. Swing gate rack attachment to the wall shall be shown.

2. Provide a typed list indicating part name, manufacturer, part number, and color (if applicable) for products specifically identified herein by the exact and complete part number (no wild-card characters)
3. Submit manufacturers cut sheets or catalog cut sheets of each of the components to be used for products not specifically identified herein by exact part number:

D. The following submittals are due at the "Project Completion" phase submission:

1. As-Builts

a. Shall show the position of the equipment racks and cabinets. Racks and cabinets shall be dimensioned and the position of the rack or cabinet shall be dimensioned from (2) walls in each Electronic Security equipment room.
b. Shop drawings for equipment racks and cabinets shall also show the detailed method of attachment to the floor and to any overhead ladder rack. All power strips and cable management raceways for equipment racks and cabinets shall be shown on the shop drawings. Swing gate rack attachment to the wall shall be shown.

PART 2 - PRODUCTS AND MATERIALS

2.1 EQUIPMENT CABINETS

A. Equipment Cabinets shall be

1. Approximately a maximum of 7ft.-6in. in height, depth as required for equipment and cable management.

    a. Rails spaced 19 inches wide and shall conform to EIA/ECA-310E.

    b. Mounting rails, holes, and panels as need for installed equipment.

2. Provided with a black painted finish, of welded construction, and have a self-supporting base.
3. Cold rolled steel units, 12 GA angles, 14 GA posts, 16 GA molding and braces.
4. Doors: 16 GA flush mount; louvered, flush pulls.
5. Panels: 16 GA flush mount; louvered, quick removal.
6. Provide flush full front door with key lock on all cabinets.
7. Provide flush full louvered rear door with key lock on racks with rear access. Provide flush full louvered panel on cabinets without access.
8. Provide ventilation grille with serviceable filter element at base of unit.
9. Provide ventilation fan where indicated on drawings or required to maintain manufacturer recommended equipment temperatures.
10. Manufactured by

    a. Hoffman
    b. Winsted
    c. Atlas Sound
    d. Middle Atlantic
    e. Cabtron

B. All cabinets shall have adjustable feet for leveling cabinets in all directions.

C. All cabinet locks shall be keyed the same.

2.2 CABLE MANAGEMENT DEVICES

A. Provide listed cable management devices, including strain relief.

B. Horizontal Cable Management

1. Provide rack units in height, depth as required for equipment and cable management.

    a. Rails spaced 19 inches wide and shall conform to EIA/ECA-310E.

b. Mounting rails, holes, and panels as need for installed equipment.

2. Provided with a black painted finish and of welded construction
3. Manufactured by

a. Hoffman
b. Winsted
c. Atlas Sound
d. Middle Atlantic
e. Cabtron

C. Vertical Lacer Strips

1. Provide rack units in height, depth as required for equipment and cable management.

a. Rails spaced 19 inches wide and shall conform to EIA/ECA-310E.

b. Mounting rails, holes, and panels as need for installed equipment.

2. Provided with a black painted finish and of welded construction
3. Provide Vertical Lacer Strips for full height of rack. Provide width and Velcro® straps to properly support cables in rack.
4. Manufactured by

a. Hoffman
b. Winsted
c. Atlas Sound
d. Middle Atlantic
e. Saginaw
f. Cabtron

2.3 POWER DISTRIBUTION UNIT (PDU)

A. Power Distribution Unit (PDU)

1. Provide 120V, 20A power distribution unit

a. Input: (1) NEMA L5-20P plug
b. Output: (14) NEMA 5-20R receptacles.

2. Provide rack mounting brackets and attach to cabinet.
3. Provided with a black painted finish.
4. Provide cord length to reach UPS. A separate extension cord is not acceptable
5. Manufactured by

a. APC

b. Leviton
c. Tripp Lite
d. IBM
e. Middle Atlantic
f. Winsted

PART 3 - EXECUTION

3.1 QUANTITIES OF RACK AND CABINET EQUIPMENT AND COMPONENTS

A. Location and placement equipment racks/cabinets and distribution frames shall be as shown on the Drawings or defined in these specifications and schedules.

B. Quantities and sizes of rack, cabinet and distribution frame equipment and components shown on the Drawings are illustrative only and are meant to indicate the general configuration of the work. Provide the correct quantities of all materials necessary to accommodate the equipment and to terminate, cross connect and patch the volume of cable described in these specifications and schedules and shown on the Drawings.

C. Equipment racks and cabinets shall be assembled and installed as per the manufacturers' printed instructions.

END OF SECTION 28 1116

SECTION 281300 - ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a security access system consisting of expansion of the Local Access Control Server, licensing for owner workstation computers, operating system and application software update, and field-installed Controllers connected by a high-speed electronic data transmission network, near and distant proximity card readers, and combination proximity card readers with number pads for Person Identification Number (PIN) entry.

1.3 DEFINITIONS

A. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.

B. CCTV: Closed-circuit television.

C. Server: A server-grade, rack mounted PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.

D. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

E. CPU: Central processing unit.

F. Credential: Data assigned to an entity and used to identify that entity.

G. dpi: Dots per inch.

H. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.

I. File Server: A PC in a network that stores the programs and data files shared by users.

J. GFI: Ground fault interrupter.

K. Identifier: A credential card, fob, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

L. I/O: Input/Output.

M. LAN: Local area network.

N. LED: Light-emitting diode.

O. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

P. PC: Personal computer. This acronym applies to the Server, workstations, and file servers.

Q. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

R. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

S. 1PIN: Personal Identification Number.

T. RF: Radio frequency.

U. ROM: Read-only memory. ROM data are maintained through losses of power.

V. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

W. RS-485: An TIA/EIA standard for multipoint communications.

X. SIA: Security Industry Association.

Y. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

Z. TWAIN: (Technology without an Interesting Name.) A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.

AA. UPS: Uninterruptible power supply.

BB. WAN: Wide area network.

CC. WAV: The digital audio format used in Microsoft Windows.

DD. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

EE. Windows: Operating system by Microsoft Corporation.

FF. Workstation: A PC with software that is configured for specific limited security system functions.

GG. WYSIWYG: (What You See Is What You Get.) Text and graphics appear on the screen the same as they will print.

1.4 FUNCTIONAL DESCRIPTION

A. Access Control systems for the buildings will be an extension of City's existing Genetec Access Control System. The each building shall include panel mounted Controllers, networked over an owner provided Ethernet network to the Owner's Access Control Server and application software located in the Administrative Building.

1. Office Building and Fleet Maintenance Building shall each have a security workstation running Genetec Client software for monitoring and control of man doors, overhead doors and gates. See drawings for doors, overhead doors and gates that have monitoring or control and monitoring.

B. User authentication shall be by MiFare proximity card readers. Access Control system will provide validation of credentials and access through controlled doors and gates and alarm reporting for duress inputs. Security access system shall include, but not be limited to the following features and functions:

1. Access Control:

a. Validating access requests through doors and site gates.
b. Remote operation of doors and site gates.
c. Local operation of overhead doors using open/stop/close stations.
d. Remote operation of overhead doors.
e. Surge and tamper protection.
f. Card readers.
g. Spare inputs for future gate control using long range card readers or radio activated gate control.
h. RS-232 ASCII interface.
i. RS-485 ASCII interface.
j. Reporting.

2. Duress:

    a. Initiation stations report to and annunciates within the access control system to monitoring locations.
    b. Audible/visual local annunciation units.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, furnished specialties, and accessories. Reference each product to a location on Drawings.

B. Shop Drawings:

1. Conduit routing and cable fill data for each conduit run.
2. Diagrams for cable management system within equipment rooms.

3. System labeling schedules, including electronic copy of labeling schedules.
4. Wiring Diagrams.

    a. Block diagram of system component connections identifying cable numbers and types.
    b. Typical wiring schematics.
    c. Point-to-point wiring schedules or diagrams.

5. Battery and UPS calculations for Server, workstations, and Controllers.
6. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
7. Graphical facility maps for use on the monitor display showing equipment locations and status.

C. Project planning documents as specified in Part 3.

D. Samples: Access control cards.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:

1. Microsoft Windows software documentation.
2. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.

3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
4. System installation and setup guides, with data forms to plan and record options and setup decisions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Division 28 Section "General Requirements Electronic Safety and Security".

B. Source Limitations: Obtain workstation, Controllers, Identifier readers, and all software through one source from a single manufacturer.

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

D. Comply with NFPA 70, "National Electrical Code."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Workstations and Controllers:

1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F, and not more than 80 percent relative humidity, noncondensing.
2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
3. Mark packing list with designations that have been assigned to materials and equipment for recording in the system labeling schedules that are generated by cable and asset management system specified in Part 2.
4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components installed in air-conditioned interior environments shall be rated for continuous operation in ambient conditions of 36 to 100 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosure.

1.9 EXTRA MATERIALS

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

1. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.
2. Identifier readers; 1 of each type installed.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. System shall consist of an existing server located at the Criminal Justice Center with networked PC-based workstations and field-installed Controllers, connected by Owner's Ethernet network.

1. System Software: Genetec (existing).

B. Network connecting the Server and workstations shall be the Owner's LAN using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations.

C. Network(s) connecting PCs and Controllers shall consist of one or more of the following:

1. Local area, IEEE 802.3 Fast Ethernet 100 BASE-TX, star topology network based on TCP/IP.
2. Direct-connected, RS-232 cable from the COM port of the Server to the first Controller, then RS-485 to interconnect the remainder of the Controllers at that Location.

2.2 PERFORMANCE REQUIREMENTS

A. Security access system shall use a single database for access-control and credential-creation functions.

B. Distributed Processing: System shall be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for access control. If communications to Server are lost, all Controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the Server.

C. Server shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Server shall control system networks to interconnect all system components, including workstation and field-installed Controllers.

D. Field equipment shall include Controllers and card readers. Data exchange between the Server and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Server shall include status data such as and entry-control records.

E. System Response to Alarms: Field device network shall provide a system end-to-end response time of 1 second or less regardless of the number of devices connected to the system. Alarms shall be annunciated by the Touch Screen Control System within 1 second of the alarm occurring at a Controller or device controlled by a local Controller, and within ½ second if the alarm occurs at the Server.

F. False Alarm Reduction: The design of Server and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.

G. Error Detection: A cyclic code error detection method shall be used between Controllers and the Server, which shall detect single- and double-bit errors, burst errors of eight bits or less, and at least 99 percent of all other multibit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Server shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.

H. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

I. Door Hardware Interface: All door interfaces shall be via the Access Control System.

2.3 SURGE AND TAMPER PROTECTION

A. Refer to Division 28 Section “General Requirements Electronic Safety and Security”.

2.4 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.5 SECURITY ACCESS SYSTEM

A. Manufacturers:

1. Genetec

2.6 SOFTWARE

A. Provide update and licensing to existing Genetec system to accommodate new site gates, building pedestrian and overhead doors, and functionality described herein.

B. Provide graphical maps of site and new buildings showing installed access control devices for status display and control input.

C. Application Software: Interface between the alarm annunciation and entry-control Controllers, to monitor sensors, limited alarm reporting, generate reports, and help train system operators. Software shall have the following functions:

1. Resides at the Server, workstations, and Controllers as required to perform specified functions.
2. Operate and manage peripheral devices
3. Import custom icons into graphics views to represent alarms and I/O devices.
4. Globally link I/O so that any I/O can link to any other I/O within the same Location, without requiring interaction with the host PC. This operation shall be at the Controller.
5. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the Controller.
6. Messages from PC to Controllers and Controllers to Controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
7. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-Controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
8. Automatic and encrypted backups for database and history backups shall be automatically stored at the workstation and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
9. Operator audit trail for recording and reporting all changes made to database and system software.

D. Workstation Software:

1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.

2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

E. Controller Software:

1. Controllers shall operate as an autonomous intelligent processing unit. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door locking schedules for its operation, independent of other system components. Controllers shall be part of a fully distributed processing control network. The portion of the database associated with a Controller and consisting of parameters, constraints, and the latest value or status of points connected to that Controller, shall be maintained in the Controller.
2. Functions: The following functions shall be fully implemented and operational within each Controller:

    a. Monitoring inputs.
    b. Controlling outputs.
    c. Automatically reporting alarms to the Server.
    d. Reporting of sensor and output status to Server on request.
    e. Maintaining real time, automatically updated by the Server at least once a day.
    f. Communicating with the Server.
    g. Executing Controller resident programs.
    h. Diagnosing.
    i. Downloading and uploading data to and from the Server.

3. Individual Controller Operation:

    a. Controllers shall transmit alarms, status changes, and other data to the Server when communications circuits are operable. If communications are not available, Controllers shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the Server, shall be stored for later transmission to the Server. Storage capacity for the latest 1024 events shall be provided at each Controller.
    b. Card-reader ports of a Controller shall be custom configurable for at least 120 different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different Controllers or within the same Controller.
    c. Controllers shall provide a response to card-readers or keypad entries in less than 0.25 seconds, regardless of system size.
    d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to its proper working state. This shall happen without any operator intervention.
    e. Initial Startup: When Controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is

completed, only database changes shall be downloaded to each Controller.

f. Failure Mode: On failure for any reason, Controllers shall perform an orderly shutdown and force Controller outputs to a predetermined failure mode state, consistent with the failure modes shown and the associated control device.

g. Startup After Power Failure: After power is restored, startup software shall initiate self-test diagnostic routines, after which Controllers shall resume normal operation.

h. Startup After Controller Failure: On failure, if the database and application software are no longer resident, Controllers shall not restart, but shall remain in the failure mode until repaired. If database and application programs are resident, Controllers shall immediately resume operation. If not, software shall be restored automatically from the Server.

4. Communications Monitoring:

a. System shall monitor and report status of RS-485 communications loop of each Location.

b. Communication status window shall display which Controllers are currently communicating, a total count of missed polls since midnight, and which Controller last missed a poll.

c. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM memory for each Controller.

5. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the Server at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

F. PC-to-Controller Communications:

1. Server or workstation communications shall use the following:

a. TCP/IP LAN network interface cards.

2. Serial Port Configuration: Each serial port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem communications incoming only"; or as an ASCII output port.

3. TCP/IP network interface card shall have an option to set the poll frequency and message response time-out settings.

4. PC-to-Controller and Controller-to-Controller communications (direct, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications shall be verified and buffered and retransmitted if not acknowledged.

G. Direct Serial or TCP/IP PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-Controller communications link.
2. Loss of communications to any Controller shall result in an alarm at all PCs running the communications software.
3. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the Controller.

H. Database Downloads:

1. All data transmissions from PCs to a Location, and between Controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
2. If a Controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the Controller to their normal working state and shall take place with no operator intervention.

3. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.

4. Software shall provide for setting delays of database downloads for dial-up connections. Delays change the download from immediately to a delay ranging from 1 to 999 minutes.

I. Operator Interface:

1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state representing output. Access system shall monitor door hardware statuses.
4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
6. Graphic maps or drawings containing inputs shall include the following:

    a. Database to import and store full-color maps or drawings and allow for input and output icons to be placed on maps.

b. Maps to provide real-time display animation and allow for control of points assigned to them.
c. System to allow inputs and outputs to be placed on different maps.
d. Software to allow changing the order or priority in which maps will be displayed.

7. Schedule Overrides of I/Os and Override Groups:

a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
b. Each schedule shall be composed of a minimum of two dates with separate times for each date.
c. The first time and date shall be assigned the override state that the point shall advance to, when the time and date become current.
d. The second time and date shall be assigned the state that the point shall return to, when the time and date become current.

8. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.

J. Operator Access Control:

1. Control operator access to system controls through password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
3. The password shall not be displayed or printed.
4. Each User shall be definable and assignable for the following:

a. Commands usable.
b. Access to system software.
c. Access to application software.
d. Individual zones that are to be accessed.
e. Access to database.

K. Operator Commands:

1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
2. Command inputs shall be acknowledged and processing shall start in not less than 1 second.
3. Tasks that are executed by operator's commands shall include the following:

a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
b. System Test: Allows the operator to initiate a system-wide operational test.

c. Zone Test: Allows the operator to initiate an operational test for a specific zone.
d. Print reports.
e. Change Operator: Used for changing operators.
f. Display Graphics: Used to display any graphic displays implemented in the system.
g. Run system tests.
h. Generate and format reports.
i. Request help with the system operation.

1) Include in main menus.
2) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
3) Provide navigation to specific topic from within the first help window.
4) Help shall be accessible outside the applications program.

j. Entry-Control Commands:

1) Enable or disable readers or keypads up to twice a day through time-zone programming.
2) Enable or disable cards or codes up to four times per day per entry point through access-level programming.

4. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:

a. Command entered is incorrect or incomplete.
b. Operator is restricted from using that command.
c. Command addresses a point that is disabled or out of service.
d. Command addresses a point that does not exist.
e. Command is outside the system's capacity.

L. Alarms:

1. System Setup:

a. Assign manual and automatic responses to incoming point status change or alarms.
b. Automatically respond to input with a link to other inputs, outputs, operator-response plans, unique sound with use of WAV files, and maps or images that graphically represent the point location.
c. 60-character message field for each alarm.

d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point.
e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
f. Allow 25 secondary messages with a field of 4 lines of 60 characters each.
g. Store the most recent 1000 alarms for recall by the operator using the report generator.

2. Software Tamper:

a. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.
b. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond their authorization level.
c. Maintain a transcript file of the last 5000 commands entered at the Server to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
d. Allow only acknowledgment of software tamper alarms.

3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.

7. Alarm Automation Interface: High-level interface to Server alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in same manner as burglar alarms, using an RS-232 ASCII interface.

M. Alarm Monitoring: Monitor tamper sensors, Controllers, and circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.

1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.

2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
3. Maps shall automatically display the alarm condition for each input assigned to that map, if that option is selected for that input location.
4. Alarms initiate a status of "pending" and require the following two handling steps by operators:

    a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
    b. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.

5. Each workstation shall display the total pending alarms and total unresolved alarms.
6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
7. Alarms shall transmit to Server in real time.
8. Alarms shall be displayed and managed from a minimum of four different windows.

    a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
    b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
    c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.
    d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.

9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
12. Identical alarms from same alarm point shall be acknowledged at same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and Controllers.

N. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.

1. Color Code:

a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
c. YELLOW: Advises operator that a zone is in access.
d. GREEN: Indicates that a zone is secure and that power is on.

2. Graphics:

a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
b. Allow reader locations to be placed on graphic maps by the drag-and-drop method.
c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on graphic map.
d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic map associated with inputs or outputs.
e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.

O. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.

1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.

2.7 SYSTEM DATABASE

A. Database and database management software are existing.

2.8 SURGE AND TAMPER PROTECTION

A. Refer to Division 28 Section “General Requirements Electronic Safety and Security”.

2.9 CONTROLLERS

A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Server or workstation for controlling its operation.

B. Subject to compliance with requirements in this Article, manufacturers may use multipurpose Controllers.

C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.

D. Alarm Annunciation Controller:

1. The Controller shall automatically restore communication within 10 seconds after an interruption with the field device network.

a. Inputs: Monitor dry contacts for changes of state that reflect reader alarm conditions.
b. Outputs: Managed by Server software.

E. Entry-Control Controller:

1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers.

a. Operate as a stand-alone portal Controller using the downloaded database during periods of communication loss between the Controller and the field-device network.
b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:

1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
2) Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control.

c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

2. Inputs:

a. Data from entry-control devices; use this input to change modes between access and secure.

b. Database downloads and updates from the Server that include enrollment and privilege information.

3. Outputs:

a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
b. Grant or deny entry by sending control signals to the device if security conditions allow.
c. Indication at the reader of successful or failed authentication of card.
d. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the Server.

4. Data Line Problems: For periods of loss of communications with Server, or when data transmission is degraded and generating continuous checksum errors, the Controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and outputting to PLC system devices.

a. Store up to 1000 transactions during periods of communication loss between the Controller and access-control devices for subsequent upload to the Server on restoration of communication.

5. Controller Power: NFPA 70, Class II power supply transformer, with 12- or 24-V ac secondary, backup battery and charger.

a. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.

b. Backup Power Supply Capacity: 90 minutes of battery supply. Submit battery and charger calculations.
c. Power Monitoring: Provide manual dynamic battery load test, initiated and monitored at the control center; with automatic disconnection of the Controller when battery voltage drops below Controller limits. Report by using local Controller-mounted LEDs and by communicating status to Server. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:

1) Trouble Alarm: Normal power off load assumed by battery.
2) Trouble Alarm: Low battery.
3) Alarm: Power off.

2.10 CARD READERS

A. Power: Card reader shall be powered from its associated Controller, including its standby power source.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. Enclosure: Suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

1. Indoors, controlled environment.
2. Indoors, uncontrolled environment.
3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

D. Display: LED or other type of visual indicator display shall provide visual and audible status indications and user prompts. Indicate power on/off, whether user passage requests have been accepted or rejected.

E. Proximity Readers:

1. Refer to contract drawing legend for models and applications.
2. Active detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card.

2.11 PUSH-BUTTON SWITCHES

A. Manufacturers:

1. Request To Exit buttons:

a. Quam CIB2.
b. Doortronics

B. Push-Button Switches: Momentary-contact push buttons, with stainless-steel switch enclosures.

1. Electrical Ratings:

a. Minimum continuous current rating of 10A at 120 V ac.

2. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
3. Enclosures shall additionally be suitable for installation in the following locations:

a. Indoors, controlled environment.
b. Indoors, uncontrolled environment.
c. Outdoors.

4. Power: Push-button switches shall be powered from their associated Controller, using dc control.

2.12 DOOR AND GATE HARDWARE INTERFACE

A. Electric Door Latches:

1. Secure side: Exit request switch within door hardware shall transmit data (closed contact) to Controller to signal a “request to exit”. Door operation without a request to exit signal shall cause a forced entry alarm. Power to lock shall be from a source dedicated to lock power, supplied by the access control contractor. Signal circuit shall be from the Controller. Electrified latches and strikes are specified in Division "Door Hardware.”

B. Door Position Switch: Signal switches shall transmit data (open contact) to Controller to indicate when the door is not engaged with the frame and shall report a non-secure door. Power and signal shall be from the Controller. Door position switches are required on all controlled doors, and selected doors as identified within the contract drawings. Switches are as specified in Division "Door Hardware.”

C. Latch Position Switch: Signal switches shall transmit data (open contact) to Controller to indicate when the door latch is not engaged with the strike and shall report a non-secure door. Power and signal shall be from the Controller. Latch position switches are required on all controlled doors, and selected doors as identified within the contract drawings. Switches are as specified in Division "Door Hardware.”

D. Power Assist Doors: Controllers shall provide control over the power assist operations of doors equipped with such. . On facility entry, controller shall not energize power assist feature without a prior valid PIN read or remote release request followed by strike release. When doors are left unlocked for free ingress, use of valid access card shall not be required to activate the power assist mechanism . On exit, push pad shall serve as a Request To Exit thereby unlatching the door followed by activation of the power assist feature.

2.13 VEHICLE GATE HARDWARE INTERFACE

A. Vehicle gates (provided by others) shall have all safety devices and control programming for safe operation. Access control system shall provide OPEN, STOP, CLOSE input to the gate control system to effect the desired operation. Gate control system shall have hierarchical control over the access control requests in the interest of safety.

1. Gate position sensors and latching mechanism will be monitored by the access control system to indicate secure or non-secure gate conditions, and to alarm should the gate become non-secure by other than a command from the access control system.
2. Gate operates independently of the access control system to close based on the gate system controller's sensor loops and safety sensors. Staff will also have the ability to "stop" the gate at any point in its travel through selecting the appropriate access control icon on their computer control screen. Interface to the gate system controller to "stop" will again be a momentary closed contract.
3. Where equipped, as an exiting vehicle approaches a closed gate, a vehicle sensor belonging to the gate system controller senses the presence of the vehicle and initiates a request to exit command to the access control system. Access control system shall grant exit to allow gate to begin its operational sequence to allow the vehicle egress, and then closing again behind the vehicle once it has passed. Access control system shall have ability to disable automatic exiting feature.
4. Staff can always command the gates to open, stop, or close thereby interrupting any automated egress sequence that may have started. Once the sequence has been interrupted, the close sequence will not resume until commanded closed by staff.

2.14 VEHICLE OVERHEAD DOOR HARDWARE INTERFACE

A. Vehicle doors (provided by others) shall have all safety devices and control programming for safe operation. Access control system shall provide OPEN, STOP, CLOSE input to the door control system to effect the desired operation. Door control system shall have hierarchical control over the access control requests in the interest of safety.

1. Door position sensors and latching mechanism will be monitored by the access control system to indicate secure or non-secure conditions, and to alarm should the door become non-secure by other than a command from the access control system.
2. Door control open/stop/close pushbuttons shall be located at each overhead door within the Bus Storage Facility as provided by overhead door contracor.
3. Door closure shall be by programmed timmer as defined by the Owner, or by operator, client station, or local door control interface.
4. Staff will have the ability to open, stop, or close overhead doors at any point in its travel through selecting the appropriate access control icon on their computer control screen. Changes in direction shall be preceded with at least a 2 second "stop" delay.
5. Staff shall always have the ability to command the doors to open, stop, or close thereby interrupting any automated egress sequence that may have started. Once the sequence has been interrupted, the close sequence will not resume until commanded closed by staff.

2.15 REQUEST TO EXIT SENSOR

A. Integral with door hardware or discrete as provided by door hardware provider.

2.16 CABLES

A. Comply with Division 28 Section "Conductors and Cables for Electronic Safety and Security."

2.17 TRANSFORMERS

A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

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

3.2 PREPARATION

A. Comply with recommendations in SIA CP-01.

3.3 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."

B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."

C. Wiring Method: Install wiring in raceway, cable tray is permissible for tray rated cable within equipment. Conceal raceway and wiring except in unfinished spaces.

D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.

E. Install cables without damaging conductors, shield, or jacket.

F. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock and tamper switch. Tamper switches shall be tied into the system for alarming at the Control stations. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

G. Install end-of-line resistors at the field device location and not at the Controller or panel location.

3.4 GROUNDING

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:

1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.5 INSTALLATION

A. Push Buttons: Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push-button switch labeled with 1/4-inch- (6.4-mm-) high text and symbols as required. Push-button switches shall be connected to the Controller associated with the portal to which they are applied, and shall signal the system to open an associated door or gate if security conditions warrant.

B. Install card readers.

3.6 IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA-606.

B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

C. At completion, contract drawings shall reflect as-built conditions as modified by installers.

3.7 SYSTEM SOFTWARE

A. Develop, install, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements.

C. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.9 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.

1. Enroll access cards for Owner's operators, management, and security personnel.

3.10 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured during periods when a qualified operator in the employ of Contractor is not present.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system. Refer to Section 28010 for additional requirements.

B. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Security personnel.
4. Hardware maintenance personnel.

END OF SECTION 281300

SECTION 282300 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes IP video surveillance system consisting of cameras, network switches, fiber to Ethernet media converters, power supplies, video servers and storage, and video management software and associated equipment,

1.3 DEFINITIONS

A. Retain acronyms and terms that remain after this Section has been edited.

B. AC: Alternating Current

C. AGC: Automatic gain control.

D. B/W: Black and White

E. Bit Rate: B/s = Bytes per second, b/s = bits per second

F. CCD: Charge-coupled device

G. DC: Direct Current

H. DSP: Digital Signal Processing

I. FTP: File Transfer Protocol

J. GB: Gigabyte

K. IP: Internet Protocol

L. IRE: Institute of Radio Engineers. Units of measurement dividing the area from the bottom of the sync to the peak white level into 140 equal units. 140 IRE equals 1 Vp-p. The range of active video is 100 IRE.

M. IR light: Infrared light

N. JPEG. Joint Photographic Experts Group

O. KVM: Keyboard, Video, Mouse

P. LAN: Local Area Network

Q. LCD: Liquid Crystal Display

R. LED: Light-Emitting Diode

S. Lumen [lm]. A unit for measuring intensity

T. Lux [lx]: a unit for measuring illumination

U. MPEG: Moving picture experts group

V. NIC: Network Interface Card

W. Pixel: Derived from picture element. Refers to CCD chip unit picture cell

X. POE: Power Over Ethernet

Y. PTZ: Pan-Tilt-Zoom

Z. RAM: Random Access Memory

AA. RAID: Redundant Array of Independent Disks

BB. UXGA: Computer screen resolution offering 1600 X1200 Pixels

CC. VGA: Video Graphics Array with resolution of 640 X 480 Pixels

DD. WAN: Wide Area Network

EE. XGA: Computer screen resolution offering 1024 X 768 Pixels

FF. UPS: Uninterruptible power supply

1.4 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Video surveillance system shall consist of IP cameras, the majority of which shall be Powered Over Ethernet (POE), connected to the owner's existing dedicated 1000T based Ethernet security network.

B. The video recording shall be by distributed video server/storage devices.

C. Network Video Recording

1. Connect to the existing network video recording system. Program cameras as per 9 below.
2. Capacity for recording cameras shall be provided to allow a minimum of 45 days of recording at 15 frames per second, using highest camera resolution with mild (10% or less) H.264 compression.
3. Video recording shall be by rack mounted video server running video management software.
4. Server shall have fault tolerant RAID 1 or better fault tolerant operating system drives.
5. Server shall have an onboard DVD burner for archiving selected video files.
6. A monitor, keyboard, and KVM switch shall be provided within the Electronic Security Equipment Rack for direct access and management of the video server and servers within the Electronic Security equipment racks. The monitor and keyboard shall have access to all management features of each server, as well as the ability to view any of the connected cameras in the facility.
7. Video storage shall be by direct-attached, hot swappable RAID 5 configured hard drives.
8. Configurable motion detection alarm output for each video channel.
9. Program camera titles and on-screen placement as coordinated with the Owner.

D. Audio Input

1. Each interview room shall have a dedicated, phantom powered microphone for recording audio with associated video.
2. Interview rooms shall have covert microphones as indicated on project plans.

1.5 SURGE AND TAMPER PROTECTION

A. Refer to Division 28 Section “General Requirements Electronic Safety and Security”.

B. Interference Protection: Component function shall be unaffected by radiated-radio-frequency interference and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz, or by conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.

1.6 SUBMITTALS

A. The following submittals are due at the “Bid” phase submission:

1. Provide unit prices for the following:

a. Camera Pricing:

1) Supply unit pricing for the addition/deletion of each type of camera.

B. The following submittals are due at the “Pre-construction” phase submission:

1. Product Data: For each type of product indicated, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
2. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

    a. Conduit routing and cable fill data for each conduit run.
    b. Device layout, which includes device type, cable type and home run routing.
    c. Diagrams for cable management system within equipment rooms.
    d. System labeling schedules, including electronic copy of labeling schedules.
    e. Wiring diagrams.

        1) Functional Block diagram of system component connections identifying cable numbers and types.
        2) Typical wiring schematics.
        3) Power, signal, and control wiring, and grounding.
        4) Point-to-point wiring schedules or diagrams.

    f. Network Video Storage: Sizing calculations.

        1) Storage size estimate for each type of camera per location type (hallway, armory, evidence processing, etc.)
        2) Schedule with all cameras listed and total storage required for video management system.

3. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.
4. Field quality-control test reports.
5. Operation and Maintenance Data: For cameras, power supplies, monitors, microphones, fiber optic components, network video recorders, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:

    a. Lists of spare parts and replacement components recommended being stored at the site for ready access.

6. Warranty: Special warranty specified in this Section.

1.7 QUALITY ASSURANCE

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

B. Comply with NECA 1.

C. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Central Equipment: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
2. Interior, Controlled Environment: System components, except central equipment, installed in air-conditioned temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosures.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing.
4. Security Environment: Camera housings for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 IP CAMERAS

A. Manufacturers:

1. Axis
2. Arecont
3. Bosch
4. Panasonic Security Systems Group
5. Pelco
6. Sony
7. Vicon

B. Refer to Contract Drawing's camera legend for performance specifics and typical model meeting performance requirements.

2.3 LENSES

A. Description: Optical-quality coated optics, designed specifically for video surveillance applications, and matched to specified camera. Provide color-corrected lenses with color cameras.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
2. Fixed Lenses: Auto remote focus.
3. Zoom Lenses: Motorized, remote-controlled units, rated as "quiet operating." Features include the following.

a. Electrical Leads: Filtered to minimize video signal interference.
b. Motor Speed: Variable.

2.4 CAMERA POWER SUPPLIES

A. Manufacturers:

1. Alarm Saf
2. Altronix
3. Bosch/Philips
4. Pelco
5. Ultrak
6. Vicon
7. WREN

B. Power Supplies: Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, type as recommended by camera manufacturer.

1. Power supplies shall be UL and CSA certified, and NEC compliant for Class 2 circuits.
2. Provide fused outputs for each camera for 24VAC service.
3. No more than one camera supplied per output termination where POE is insufficient.
4. Provide power limiting.
5. Do not exceed 80VA per power supply.
6. Enclosure: Type 1.

2.5 CAMERA-SUPPORTING EQUIPMENT

A. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

B. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

C. Secure mounting equipment with expansion anchors rated for the load, independent of other anchors.

2.6 VIDEO MANAGEMENT SOFTWARE

A. Manufacturers:

1. Genetec

B. The video management system (VMS) shall be an enterprise-class client/server based IP video security solution that provides seamless management of digital video, audio and data across an IP network. The video management system shall work with CCTV products as part of a total video security management system to provide full virtual matrix switching and control capability. The video management system consists of Central Servers, Recording Services, Configuration client, and Operator Clients (for client workstations). Cameras, recorders, and viewing stations may be placed anywhere in the CCTV system IP network.

C. The system’s server components shall run on Windows 2012 Server.

D. The system’s clients shall run on Windows 7 Pro.

E. Support for all standard and high definition H.264 and MPEG-4 Encoders, Decoders, IP Cameras, IP PTZs.

F. Provide at least 10 different and independent programmable recording schedules. The schedules may be programmed to provide different record frame rates for day, night, and weekend periods as well as special days. Advanced task schedules may also be programmed that could specify allowed logon times for user groups, when events may trigger alarms, and when data backups should occur.

G. Allow the establishment of user groups that have access rights to specific cameras, priority for pan/tilt/zoom control, rights for exporting video, and access rights to system event log files. Access to live, playback, audio, PTZ control, preset control, auxiliary commands shall be programmable on an individual camera basis.

H. Auto discover all cameras, encoders, and IP video devices.

2.7 VIDEO SERVERS

A. Manufacturers:

1. Dell
2. Hewlett Packard
3. IBM
4. Lenovo

B. Network Video Servers

1. Meets minimum recommended requirements for Video Management Software, but not less than the following:

    a. IBM-compatible computer housed in an industrial rack-mountable chassis and having the following:

        1) CPU Speed and Capacity: Intel Xeon E5-2609; 10MB Cache, 2.40 GHz, 6.40 GT/s Intel QPI.
        2) RAM: 12GB
        3) Redundant hot-plug power supply
        4) Disk Drives: 500GB in RAID 1 Minimum
        5) CD-ROM Drive: 16x DVD -R/RW, +R/RW
        6) Video card supporting DVI monitor output
        7) Network Interface Cards: 2 - Gigabit Ethernet RJ-45 ports (1000Base-T)
        8) Operating System: Windows Server 2012

2. Maximum allowable number of IP video streams to be assigned: 32 each server (including unused capacity to meet growth percentages indicated).
3. Mounting: Standard 19-inch (483-mm) rack complying with EIA 310.
4. Storage: Each server shall have sufficient on-board or direct connected disk capacity to record each assigned video channel and maintain a rolling record of the video data on a first in first out basis meeting the project's archival requirements.

2.8 VIDEO STORAGE

A. Manufacturers:

1. Dell
2. Hewlett Packard
3. IBM
4. Pivot3

B. Direct Attached Storage, rack mounted, meeting the following requirements:

1. Modular, expandable
2. 12 hard drive bays per chassis
3. Hot-swappable 3.5" hard drives, quantity and size to meet recording and archive requirements; min 16 TB.
4. RAID 5 configured.
5. 6Gb SAS cable connected.

2.9 KVM SWITCH AND MONITOR

A. Color:

1. Display Technology: LCD Flat panel with DVI input.
2. Minimum Screen Size (Diagonal Dimension): 17"
3. Minimum Front Panel Devices and Controls: Power switch, power-on indicator, and brightness, contrast, color, and tint controls.
4. Keyboard: Standard with trackball mouse.
5. Mounting: keyboard height at 44" AFF with rack
6. Channels: As required for the number of servers, DVI video switching.
7. Electrical: 120-V ac, 60 Hz.

2.10 VIDEO AND ACCESS CONTROL CLIENT STATION

A. Client stations shall be connected to the ESN for remote viewing of camera video, both real-time and recorded, and view access control workstation software.

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

1. CPUs

   a. Dell
   b. Hewlett Packard
   c. IBM

2. Monitors

a. Dell
b. Hewlett Packard
c. NEC

C. Include the following minimum features, components, and capabilities:

1. CPU: IBM-compatible computer housed in an industrial chassis and having the following requirements:

a. CPU Speed and Capacity: Intel Core i7 2600, 3.40GHz, 8M L2 Cache 1333MHz FSB
b. RAM: 4GB installed, expandable to 8GB
c. Fixed Disk Drive: 320GB
d. CD-ROM Drive: 16x DVD –R/RW, +R/RW
e. Sound Card: Sound Blaster Audigy SE or better.
f. Network Interface Cards: dual DVI out, 1Gb min. matched to protocol and media used for each network.
g. Operating System: Windows 7 Pro

2. Models: Dell OptiPlex 990 MT or equivalent.
3. Monitors: 24 inches LCD

a. On-Screen Colors: 16.7 million
b. 300 cd/m2
c. Response Time: 12ms
d. DVI

4. Peripheral Components:

a. Keyboard
b. Mouse: Two button model, scrolling.

2.11 SIGNAL TRANSMISSION COMPONENTS

A. PoE network switches provided by owner.

2.12 UTP CABLE TERMINAL BLOCKS

A. See specification section 271119 Communications Termination Blocks and Patch Panels.

2.13 PATCH PANELS

A. See specification section 271119 Communications Termination Blocks and Patch Panels.

PART 3 - EXECUTION

3.1 WIRING

A. Comply with requirements in Division 28 Section "General Requirements for Electronic Safety and Security" for conduit requirements.

B. Retain paragraph above or first paragraph below. Delete both if wiring method is indicated on Drawings.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Retain paragraph below only if required by manufacturer. Show independent-signal circuit-grounding methods and details on Drawings.

F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.2 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

B. Refer to contract drawings for installation heights.

C. Install power supplies and other auxiliary components at Server room, unless otherwise indicated.

D. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system component enclosures, and mounted in self-protected, inconspicuous positions.

E. Perfect all fixed camera views with respect to aiming, field of view, and focus at the Owner’s direction.

F. Program camera titles and on-screen placement as coordinated with the Owner.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation and supervise pretesting, testing, and adjusting of video surveillance equipment.

B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

C. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video surveillance equipment for acceptance and operational testing as follows:

1. Prepare equipment list described in Part 1 "Submittals" Article.
2. Verify operation of auto-iris lenses.
3. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
4. Set sensitivity of motion detection.
5. Connect and verify responses to alarms.
6. Verify operation of control-station equipment.

D. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

E. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

F. Remove and replace malfunctioning items and retest as specified above.

G. Record test results for each piece of equipment.

H. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.

3. Adjust all preset positions; consult Owner's personnel.
4. Provide a written report of adjustments.

3.5 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video surveillance system components, including camera-housing windows, lenses, and monitor screens.

3.6 DEMONSTRATION

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

1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
3. Review equipment list and data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data"
4. Conduct a minimum of four hours' training to Owner's employees. Provide tutorial on software and device components.

END OF SECTION 282300

SECTION 285000 - INTERCOM TELEPHONE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Recessed, pedestal-mounted speakerphone stations.
2. Conductors and cables
3. Raceways

1.3 DEFINITIONS

A. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. IP: Internet Protocol.

E. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

F. LED: Light Emitting Diode.

G. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

H. NRTL: Nationally Recognized Testing Laboratory.

I. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

J. PTZ: Pan-Tilt-Zoom.

K. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

L. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

M. UTP: Unshielded twisted pair.

1.4 FUNCTIONAL DESCRIPTION

A. Intercom telephone system is a functional extension of the owner's existing system.

B. Intercom telephone system shall consist of multiple self-powered, outdoor-rated, vandal resistant and ADA-compliant hands-free speakerphone communications devices having a stainless steel faceplate with a single metal call button. Devices shall wire to the facilities telephone system.

C. Pressing the call button on the intercom speakerphone telephone shall:

1. Initiate a telephone call to a pre-programmed telephone number. Should that number be busy or the calling station not receive an answer, a second number shall automatically be dialed.
2. Close an auxiliary contact set for alarming input to the access control system for alarm display and mapping at any designated access control workstation. Also ring the intercom bell in Fleet Maintenance Building when intercom at delivery door is activated.

D. Intercom call stations shall consist of a recessed mounted, speakerphone telephone station having a single, ADA accessible button.

1.5 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments.

1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.

2. Include scaled drawings.

C. Coordination Drawings: Drawn to scale showing location and attachment to mounting surface.

D. Qualification Data: For qualified Installer per this Division.

E. Operation and Maintenance Data: Include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

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

1.7 COORDINATION

A. Coordinate layout and installation of devices with other construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INTERCOM TELEPHONE SYSTEM

A. Available Manufacturers:

1. Code Blue, Holland, MI
2. GAI-TRONICS, Mohnton, PA
3. Talk-A-Phone, Chicago, IL.

2.3 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form a secure and operable system.

B. Coordinate back box requirements for flush mounting devices as indicated by equipment manufacturer.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated.

2.4 INTERCOM SPEAKER PHONE

A. The Speakerphone Phone shall have one red anodized aluminum tactile button labeled "INTERCOM" and one 0.375" diameter red light emitting diode (LED) labeled "LIGHT ON INDICATES CALL RECEIVED". The unit shall be programmable from a remote location and have a two number dialing capability, reverting to the second number if the first is busy or does not respond. The unit shall be totally hands-free on both sides after connection is initiated at site or by attendant. The unit shall be phone line powered, requiring no outside power source or battery back-up. Each unit shall have a dedicated communication line to the City Utilities PBX system.

B. Construction:

1. Chassis and face plate shall be constructed of stainless steel.
2. Faceplate shall be 12 gauge #4 brushed stainless steel measuring 9.5" W x 11.75" H.
3. Signage shall be constructed of cast metal with lettering and Braille raised approximately 3/32" for ADA compliance.
4. Word "INTERCOM" and button shall be red.
5. Push button and switch shall be:

    a. Rated for 1,000,000 cycles in temperatures from -55ºC to +80ºC.
    b. Button shall be red anodized aluminum.
    c. Seals shall protect contacts and terminals from hostile environments and solder flux. Unit shall be waterproof and submergible to 3 feet in water.
    d. Case shall be moisture-proof, dust-tight and designed to accommodate the high shock military specifications of MIL-STD-202, method 207.
    e. Case shall be aluminum alloy, anodized clear.

6. Speaker and microphone shall be protected by non-ferrous metal screen to provide a barrier against vandalism, rain and snow.

    a. Speaker: Unit shall have a 3.5 inch waterproof speaker with a vinyl-impregnated cloth cone. Magnet and solid aluminum voice coil area shall be protected from ferrous and non-ferrous particles by a special sealed design. The speaker shall be capable of operating without deterioration of sound quality after total immersion in water for 96 hours. Speaker shall operate at temperatures of -55ºC to +85ºC. Steel basket shall have a zinc dichromate finish for protection against corrosion.
    b. Microphone: Unit shall be water-resistant.

7. PC boards and Other Electronic Components: Boards and components shall withstand a corrosive atmosphere of 90% H_2S for 16 hours. PC boards shall be rated R4. Unit shall be designed to operate at temperatures from -20ºC to +65ºC and humidity levels up to 95% relative humidity at 49ºC.
8. Protective Sealing of Completed PC Boards: Once the unit has been wave soldered and inspected and the completed boards tested, the entire circuit board apparatus shall be conformally coated by dipping rather than spraying

(Mil-I416058C amend 6). The microprocessor chip shall then be installed in its socket and sealed in place with a special electrical grade RTV type sealant. At this point the boards can be sprayed with water without affecting the operation of the unit.

C. Functionality:

1. Unit shall be capable of operating on standard phone lines or analog PBX extensions.
2. Unit shall dial at approximately 10 tones per second.
3. Output sound level shall be greater than 80 dB at one meter for normal conversation.
4. All programming shall be stored in non-volatile EEPROM memory.
5. Button shall provide tactile feedback.
6. Unit shall be programmable from a remote telephone via keypad entry.
7. Call timer shall be programmable from 1 to 4320 minutes.
8. LED for the hearing impaired shall illuminate to indicate when calling party may speak (when receiving party is silent).
9. Unit shall be programmable with two different telephone numbers of up to 18 digits each including pauses. If first number does not answer or is busy, unit shall automatically call the second number. If that number is busy or does not answer, unit shall call the first number again. Unit shall continue alternating until call is answered or call timer limit is reached.
10. Unit shall include two auxiliary outputs and one auxiliary input that are opto-isolated from the telephone line to 1,000 volts. Outputs shall be activated, providing a dry contact closure, either automatically when Intercom Phone is activated or manually by guard keypad operation. Input shall allow unit to be activated by any device or switch that provides a contact closure.
11. Incoming and outgoing volume shall be adjustable separately.
12. Unit shall be capable of automatically notifying attendant of location via programmable 6 digit ID.
13. Unit shall be capable of silent monitoring.
14. Unit shall utilize tone dialing.
15. When call is finished, unit shall automatically shut off.
16. Unit shall answer any call placed to it from any other telephone.
17. Two levels of programmable passwords shall be available.
18. Unit shall be varistor lightening suppressed and full wave polarity guarded.
19. Unit shall be compatible with Talk-A-Lert® diagnostics/base-station package, model ETP-TAL.
20. Unit shall comply with Part 68 of the FCC rules for the United States.

2.5 INTERCOM DOORBELL

A. Available Manufacturers:

1. Federal Signal A10
2. Approved Equal

B. Heavy duty vibration bell.

C. 112 decibels at 1 meter.

2.6 RACEWAYS

A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Comply with requirements in Division 28 Section "Electronic Safety and Security" for conduit requirements.

B. All site wiring shall be wet location rated.

3.2 INSTALLATION OF RACEWAYS

A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

3.3 INSTALLATION

A. Closely follow manufacture's installation instructions. Field adjustable settings shall be performed with the Owner present to achieve satisfactory performance.

3.4 FIELD QUALITY CONTROL

A. Inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Operational Test:

a. Verify proper dialing and backup dialing as well as call answering.
b. Verify complete operation with switch operation.

3.5 DEMONSTRATION

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

END OF SECTION 285000

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 GENERAL

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

1.2 SUMMARY

A. This Section includes the following:
   1. Removing existing vegetation
   2. Clearing and grubbing.
   3. Stripping and stockpiling topsoil.
   4. Removing above- and below-grade site improvements.

B. Related Sections include the following:
   1. Division 31 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Topsoil: Topsoil is defined in other Sections.
   1. Existing topsoil may require screening or amendment before being considered suitable for use.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earthwork".
   1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper and timely completion.

   1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

C. Use all means necessary to control dust on and near the work, and on and near off-site storage, and spoil areas, if such dust is caused by performance of the work of this Section, or if resulting from the condition in which Project Site is left by Contractor.

D. Moisten surfaces, as required, to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on Project Site.

3.3 UTILITIES

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner’s written permission.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, shrubs, grass, and other vegetation to permit installation of new construction.
   1. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
   2. Chip removed material and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Dispose of excess topsoil as specified for waste material disposal.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, and gutters as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000 - EARTHWORK

PART 1 - GENERAL

1.1 REFERENCE SPECIFICATIONS

A. *Missouri Standard Specifications for Highway Construction*, latest edition, as published by the Missouri Department of Transportation (MoDOT), to the extent referred to.

1.2 RELATED DOCUMENTS

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

B. A geotechnical report, titled “Geotechnical Report, CITY OF ST. CHARLES – NEW PUBLIC WORKS FACILITY, SAINT CHARLES, MISSOURI” and dated June 2013 has been prepared by SCI Engineering, Inc., 130 Point West Boulevard, St. Charles, Missouri and is included for reference. The recommendations of the geotechnical report form a part of this section and shall be complied with.

1.3 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Base course for concrete pavements.
5. Excavating and backfilling for utility trenches.
6. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Divisions 21, 22, 23, 26, 27, and 28 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
2. Division 31 Section "Site Clearing" for, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.4 DEFINITIONS

A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The uppermost surface of an excavation, including excavation for trenches, or the top surface of a fill or backfill immediately below base course, pavement, drainage fill, or topsoil materials.

C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. Base Course: The layer placed between the subgrade and surface pavement in a paving system.

E. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.

F. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

H. Utilities include underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

I. Unforeseen Excavation: Excavation of material, regardless of its character or nature, below the subgrade elevation required to construct the work as indicated on the drawings or specified herein.

J. Bedding Material: Granular material utilized to bed piped utilities placed in trench excavations.

K. Backfill: Soil material, aggregate, or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

L. Fill: Soil materials used to raise existing grades.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Geotextile drainage fabric.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.

2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Testing and Inspection Service: Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soil materials to verify that soils comply with specified requirements and to perform required field and laboratory testing.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

C. Utilities have been located from surveys and available existing records. Not all utilities may be shown on the Drawings. Locate all utilities prior to beginning any construction activities.

D. Where utilities require adjustment or relocation to construct the Work, and those utilities are shown on the Drawings, relocation or adjustment is a part of the Work and shall be completed at no additional expense to the Owner.

E. Where utilities require adjustment or relocation to construct the Work, and those utilities are not shown on the Drawings, notify Owner before proceeding. Relocate or adjust utility as directed. Utility relocation and/or adjustment will be paid for according to the Contract provisions for changes in Work.

F. If utility is damaged by Contractor, notify utility owner and Owner immediately. Repair or replacement of utilities damaged by Contractor, whether utilities are shown on the drawings or not shown on the drawings, shall be Contractor's expense.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups CL, ML, CL-ML, SP, SW, GP, and GW free of organic material, rock or gravel larger than 2 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups not included in article 2.1.B.

1. Unsatisfactory soils also include satisfactory soils not maintained between 2 percent below optimum moisture content and 2 percent above optimum moisture content at time of compaction.

D. Structural Fill: Lean clay soils having a liquid limit less than 45 and plasticity index less than 25.

E. Base Course: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel; with gradation complying with MoDOT Type 5 aggregate gradation requirements and the fraction passing the No. 40 sieve having a plasticity index not exceeding 6; and free of sand, silt, deleterious rock and shale.

F. Bedding Material: Clean, granular materials of crushed rock or pea gravel with not less than 95 percent passing a 3/4 inch sieve and not less than 95 percent retained on a 3/8 inch sieve.

G. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and not more than 5 percent passing a No. 8 sieve.

H. Granular Backfill: Washed, clean, granular drainage material consisting of 1-inch crushed rock; ASTM D 2487 classification GP; with less than 5 percent passing the No. 200 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.

5. Green: Sewer systems.

C. Geotextile Fabric: Mirafi 140N, or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls during earthwork operations.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Borrow Material: If excavated materials of a suitable nature are not of sufficient quantity to complete the work, provide borrow material in sufficient quantity to complete the work at no additional cost to the Owner. Soil materials from portions of the site where no development is indicated are not available for use.

C. Disposition of Excavated Material: Dispose of excess satisfactory soil material and all unsatisfactory soil material and rock obtained from excavations in accordance with the provisions of this Section.

3.5 STABILITY OF EXCAVATIONS

A. Comply with local, state, and federal codes, ordinances, and regulations regarding maintaining safe and stable excavations.

3.6 EXCAVATION FOR BUILDING AREAS

A. Excavation for the building areas, extending a minimum of five feet beyond the building footprint, shall extend to a depth of 36-inches below the bottom of the drainage fill course to be placed under the building slabs. For the purposes of this contract the elevation of the surface at the completion of this excavation is the subgrade elevation for the building area.

B. Excavation for building footings shall extend to a depth of 24-inches below the bottom of the footings. For the purposes of this contract the elevation of the surface at the completion of this excavation is the subgrade elevation for the footings.

C. Following excavation to the above described subgrade elevations for the building areas; the exposed subgrade shall be evaluated by the Owner's Testing and Inspection Service. The Contractor shall be responsible for scheduling this subgrade evaluation.

D. If, in the opinion of the Owner's Testing and Inspection Service, the subgrade materials are unsuitable, the unsuitable materials shall be removed to the extent and depth required by the Owner's Testing and Inspection Service and replaced with materials approved by, and placed in accordance with, the requirements of the Owner's Testing and Inspection Service.

1. Excavation and disposal of unsuitable material below building subgrade elevation and replacement of that material with suitable material will be paid according to the Contract provisions for changes in the Work.
2. Excavation, utilization, and / or disposal of materials, whether suitable or unsuitable, to the building subgrade elevation is included in the Work of this Contract

3.7 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance

of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.8 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavation under walks and pavements, extending a minimum of 2 feet beyond the limits of pavement, shall extend to a depth of 18-inches below the bottom of the base course to be placed under pavements. For the purposes of this contract the elevation of the surface at the completion of this excavation is the subgrade elevation for the pavement area.

3.9 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
2. Where utilities are in fill, compact fill material to 95% standard proctor maximum dry density at least 12" above the top of the proposed utility prior to excavation of trench.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms when no bedding course is indicated: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. If rock or other unyielding material is encountered at required trench bottom elevation, excavate trenches 6 inches deeper than subgrade elevation required to allow for installation of a 6 inch thick bedding course.

    a. Excavation and disposal of rock or other unyielding material below required trench bottom elevation and replacement of that material with bedding material will be paid according to the Contract provisions for changes in the Work.

D. Trench Bottoms when bedding course is indicated: Excavate trenches to depth below bottom of utility indicated to allow for bedding course. Hand excavate for bell of pipe.

3.10 SUBGRADE INSPECTION

A. Notify Architect and Owner's Testing and Inspection Service when excavations have reached required subgrade.

B. If Owner's Testing and Inspection Service determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade immediately prior to placing subsequent fill materials with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades. Continue excavation of unsatisfactory material and replaced with compacted backfill or fill material as directed.

1. Unforeseen additional excavation and replacement material will be paid according to Contract provisions for changes in Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's Testing and Inspection Service at no additional cost to Owner.

3.11 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi may be used when approved by Owner's Testing and Inspection Service.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Owner's Testing and Inspection Service.

B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Owner's Testing and Inspection Service.

C. All additional costs incurred as a result of unauthorized excavation are the Contractor's responsibility.

3.12 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.13 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

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

3.14 UTILITY TRENCH BACKFILL

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

B. Place and compact bedding course on trench bottoms where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of material indicated, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

D. Coordinate backfilling with utilities testing.

E. Fill voids with approved materials while shoring and bracing, and as sheeting is removed.

F. Place and compact final backfill of material indicated to final elevation required.

G. All utility trenches that penetrate beneath buildings must be sealed to prevent water intrusion through trenches that could migrate below building slabs. Construct a “trench plug” extending from the building face to 5 feet beyond the building face by backfilling entire trench with Structural Fill, placed, moisture conditioned, and compacted as specified herein.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.15 FILL, GENERAL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Place soil fill on subgrades free of mud, frost, snow, or ice.

C. Bench sloped surfaces steeper than 1 vertical to 5 horizontal prior to placing fill material to provide level surfaces for fill placement. Benches shall be spaced such that the maximum height of the cut at the up-slope end of the bench is less than 5 feet.

D. Schedule and complete subgrade inspection, remove and replace any unsatisfactory soil materials, and proof roll subgrade, all as specified in Paragraph 3.10.

E. Immediately prior to placing fill, scarify exposed subgrade to a depth of 8 inches. Moisture condition scarified depth of material to a moisture content between 2 percent below optimum moisture content and 2 percent above optimum moisture content. Recompact scarified material to not less than 90 percent of modified Proctor maximum dry density as determined by ASTM D1557. Maintain moisture content within the limits specified above until placement of subsequent layers of fill material.

F. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas use “Satisfactory Soils” obtained from excavations or borrow sources.
2. Under concrete walks, concrete pavements, concrete ramps, and concrete steps or stairs use “Base Course” of thickness indicated with “Structural Fill” to provide a minimum compacted thickness of 18 inches of “Structural Fill” below “Base Course”, and with “Satisfactory Soils” obtained from excavations or borrow sources below the “Structural Fill”.
3. Under footings and foundations, use “Structural Fill” to provide a minimum compacted thickness of 24 inches below the bottom of footing or foundation.
4. Under building slabs, use “Drainage Fill” of thickness indicated with “Structural Fill” to provide a minimum compacted thickness of 36 inches of “Structural Fill: below the “Drainage Fill” , and with “Satisfactory Soils” obtained from excavations or borrow sources below the layer of “Structural Fill”.
5. In embankments to construct Bioretention Basins and Extended Dry Detention Basins use cohesive soils with a plasticity index not less than 20.

3.16 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to between 2 percent below optimum moisture content and 2 percent above optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise “Satisfactory Soil” material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified density.

3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of modified Proctor maximum dry density according to ASTM D 1557:

1. Under structures, building slabs, steps, stairs, walks, ramps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill material to not less than 90 percent of modified Proctor maximum dry density.
2. Under lawn or unpaved areas, scarify and recompact top 8inches below subgrade and compact each layer of backfill or fill material to not less than 85 percent of modified Proctor maximum dry density.

3.18 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.19 BASE COURSES

A. Place base course on subgrades free of mud, frost, snow, or ice.

B. Under concrete pavements, walks, steps, stairs, and ramps place “Base Course” on prepared subgrade and as follows:

1. Compact base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of modified Proctor maximum dry density according to ASTM D 1557.
2. Shape base course to required crown elevations and cross-slope grades.

3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.20 DRAINAGE FILL

A. Place drainage fill on subgrades free of mud, frost, snow, or ice.

B. Under slabs-on-grade, place “Drainage Fill” course on prepared subgrade and as follows:

1. Compact drainage fill course to required cross sections and thickness to not less than 95 percent of modified Proctor maximum dry density according to ASTM D 1557.
2. When compacted thickness of drainage fill course is 6 inches or less, place materials in a single layer.
3. When compacted thickness of drainage fill course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.21 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner’s Testing and Inspection Service.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

1. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gauges according to ASTM D 3017.
2. When field in-place density tests are performed using nuclear methods, make calibration check of both density and moisture gauges at the beginning of work, on each different type of material encountered, and at intervals directed by the Architect.

3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
4. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
5. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 2000

SECTION 321313 – CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs.
4. Sidewalks.
5. Ramps.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete”.
2. Division 31 Section "Earthwork" for subgrade preparation, grading, and base course.
3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 SUBMITTALS

A. General: Submit according to the following:

1. Each sheet or page of each submittal shall bear the review stamp of the Contractor indicating the submittal has been reviewed and is approved. Submittals not bearing the Contractor's review stamp will be returned without review.
2. Contract drawings may not be reproduced in whole or in part to be utilized as a submittal. Contract drawings reproduced in whole or in part and modified into submittals will not be accepted and will be returned without review.
3. Submittals shall be complete and clearly indicate compliance with specified requirements. Submission of a typical nature for separate components or items but not indicating the specifics of each will not be accepted and will be returned without review.

B. Concrete mix designs for each class of concrete. Submittal shall establish weights and volumes of all materials used for each class of concrete in accordance with ACI 318, and shall include the following:

1. Concrete mix proportions.
2. Documentation of test records and standard deviations for field experience method or,
3. Laboratory test results for trial batch method.
4. Materials certificates for cements, fly ash, and aggregates. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds the specified requirements.
5. Product data sheets for admixtures. Provide certifications from admixture manufacturers that chloride content complies with specified requirements.

C. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, and curing compounds.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Concrete paving sub-contractor / installer shall be an experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance. Concrete paving subcontractor / installer must submit qualifications including descriptions and data for at least five (5) projects, similar in character to the work of this Project, completed within the last five (5) years. At least two (2) of the completed projects must include concrete highway / roadway construction for public agencies. Include references of an individual, including name and telephone; representing the Owner of each project submitted who is personally knowledgeable of the work performed for verification of satisfactory performance.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

E. Concrete Standards: Comply with provisions of the following Standard's, except where more stringent requirements are indicated.

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
2. ACI 318, "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

1.5 COORDINATION

A. Coordinate with equipment and integral anchors, and other items embedded in concrete.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed, epoxy coated.

B. Plain Steel Wire: ASTM A 82, as drawn.

C. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60, epoxy coated. Cut bars true to length with ends square and free of burrs.

D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed, epoxy coated.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Cementitious Materials: Cementitious materials shall meet the current requirements of ASTM C 595 Type IP or IS Blended Hydraulic Cements (including the optional mortar expansion test) as outlined herein. ASTM C 595 includes blending of ASTM C 150 Portland Cement and pozzolanic materials or granulated blast-furnace slag. Cementitious materials may be blended at the ready mix plant.

1. Manufactured ASTM C 595 Blended Hydraulic Cements Type IS and Type IP must comply with all ASTM C 595 standard requirements (including the optional mortar expansion test) with the following limitations:
    a. Type IS: The slag constituent shall be between 25% and 40% of the mass of the combined Portland cement and slag.
    b. Type IP: The pozzolan constituent shall be between 15% and 30% of the mass of the combined Portland cement and pozzolan.
2. Ready mix plant (field mixed) cementitious materials shall comply with the current requirements of ASTM C 595 Type IS or Type IP Blended Hydraulic Cements (including the optional mortar expansion test) with the following limitations:
    a. Ground granulated blast furnace slag (GGBFS) shall meet the requirement of ASTM C 989 and shall be grade 100 or 120.
    b. Maximum limit by mass of GGBFS in field mixed Type IS cements shall be between 25% and 40%.
    c. Maximum combination of GGBFS and pozzolans shall not exceed 40% by mass of cementitious materials.
    d. Maximum limit by mass of pozzolanic content in field mixed Portland – pozzolan Type IP cements shall be between 15% and 25%.
    e. All fly ash used shall meet the requirements of ASTM C 618 Class F with the following exceptions:
        1) Available alkali is limited to a maximum of 1.5%.
        2) Loss on ignition is limited to a maximum of 3.0%
3. The total mass of Portland cement shall be a minimum of 360 pounds per cubic yard of concrete.
4. The total mass of cementitious materials shall be a minimum of 564 pounds per cubic yard of concrete.
5. Mortar expansion for field mixed Type IP cements blended from ASTM C 618 Type F fly ash is accepted if the eight week maximum expansion of 0.060% is met.

B. Coarse Aggregate: ASTM C 33, uniformly graded, from a single source, composed entirely of granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite, or trap rock. All coarse aggregate shall come from a large, accessible, uniform geological formation and be easily field identified in concrete. All coarse aggregate test results shall not exceed the following percentages by weight.

1. AASHTO T 103, Soundness by Freeze / Thaw 50 cycles: 1.0% for 3/4-inch to 3/8-inch, 2.0% for 3/8-inch to #4.
2. ASTM C 127, Absorption: 0.5%
3. ASTM C123, Lightweight Pieces: 0.5%

4. ASTM C 142 Clay Lumps and Friable Percent Deleterious: 0.3%
5. Coal and Lignite: 0.05%
6. ASTM C 117, Material Finer than #200 by washing: 0.5%
7. Total deleterious material: 1.0%
8. ASTM C 88, Sulfate Soundness (MgSO4) Weighted Percent Loss: 0.5% for 3/4-inch to 3/8-inch, 4% for 3/8-inch to #4.
9. ASTM C 131 LA Abrasion Percent Loss: 28.0%

C. Fine Aggregate: ASTM C 33, with the percentage by weight of clay lumps and friable particles not exceeding 0.25%, the percentage by weight of material passing the No. 200 sieve not exceeding 2.0%, and the percentage of coal and lignite not exceeding 0.25%.

D. Water: Potable, ASTM C 94.

2.4 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116, Type III, ½ to 1-1/2 inches long.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain no chloride ions.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C 1059, Type II, non-re-dispersible, acrylic emulsion or styrene butadiene.

2.8 RELATED PRODUCTS

A. Wheel Stops: Precast, air-entrained concrete, 3000-psi minimum compressive strength, 4-1/2 inches high (minimum) by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length, grouted.

2.9 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

C. Proportion mixes to provide concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi.
2. Maximum Water-Cementitious Materials Ratio: 0.44.
3. Slump Limit: 3 inches.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer’s recommended rate, but not less than 1.5 lb / cubic yard.

F. Aggregates: Aggregates must be proportioned to have a minimum of 50% coarse aggregate by weight.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content by volume of 6.5% within a tolerance of plus or minus 1.5 percent:

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

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

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Check for unstable areas and verify need for additional compaction. Proceed with concrete placement only after nonconforming conditions have been corrected.

B. Remove loose material from surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork and screeds for grade and alignment to following tolerances:

1. Top of Forms: Not more than 1/16 inch in 10 feet.
2. Vertical Face of Longitudinal Axis: Not more than 1/8 inch in 10 feet.

C. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 PLACING STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.4 JOINTS

A. General: Construct construction, isolation, and control joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing concrete, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of concrete and at locations where concrete operations are stopped for more than one-half hour, unless concrete terminates at expansion joints.

1. Continue reinforcement across construction joints, unless otherwise indicated.
2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips where indicated.

1. Extend joint fillers full width and depth of joint.
2. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface to allow for installation of joint sealant.
3. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
4. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length and provide and install expansion cap or tube to prevent concrete bonding to one side of joint.

E. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated Construct control joints for a depth indicated, as follows:

1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random cracks.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from base surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

D. Do not add water to concrete during delivery, at Project site, or during placement.

E. Deposit and spread concrete in a continuous operation between joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

G. Screed surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

H. Do not operate equipment on concrete until concrete has attained 85 percent of its 28-day compressive strength.

I. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

J. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and base just before placing concrete. Keep base course moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or

inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Re-float surface immediately to uniform granular texture.

1. Medium -Textured Broom Finish: Draw a broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, medium texture at all locations unless otherwise specified.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 WHEEL STOPS

A. Install wheel stops in bed of adhesive as recommended by manufacturer.

B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.9 TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/2 inch, unless otherwise indicated on the Drawings.
2. Thickness: Plus 3/8 inch, minus 1/4 inch
3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Edge: 1/2 inch
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Edge: Length of dowel 1/4 inch per 12 inches
8. Joint Spacing: 3/4 inches
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Allow testing agency to inspect and test subgrade preparation and base course installation. Proceed with subsequent work only after test results for previously completed work comply with requirements.

C. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.

7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
9. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi. When 7-day test is less than 70 percent of 28-day requirement, concrete may not gain adequate strength. Notify Architect in writing and acknowledge potential non-complying concrete.

D. Test results shall be reported in writing to Architect, concrete manufacturer (as applicable), and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as the sole basis for approval or rejection.

F. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory areas with Portland cement concrete bonded with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from concrete for at least 14 days after placement. When construction traffic is permitted, maintain concrete as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete free of stains, discoloration, dirt, and other foreign material. Sweep concrete not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Isolation and control joints within cement concrete pavement.

B. Related Sections include the following:

1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
2. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
3. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

C. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 or manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
3. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
4. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the commencement of the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
3. When joint substrates are wet or covered with frost.
4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

2.3 HOT-APPLIED JOINT SEALANTS

A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

B. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 321373