WMF

WEBER MURPHY FOX

ARCHITECTURE INTERIORS CONSTRUCTION MANAGEMENT
LAND PLANNING & DEVELOPMENT HISTORIC PRESERVATION

PENN STATE UNIVERSITY HARRISBURG

STADIUM SEATING & RESTROOMS BUILDING

PROJECT MANUAL

PSU PROJECT NUMBER: 00-08713.00
PSU BUILDING NUMBERS:
HB 0985-113 RESTROOM BUILDING
HB 0985-114 PRESS BOX
HB 0985-115 SPECTATOR SEATING
WMF Project Number. 2022.138.00
Date: January, 2024

403 SOUTH ALLEN STREET, SUITE 115, PENNSYLVANIA 16801
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CLEVELAND ERIE STATE COLLEGE

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DIVISION 22 - PLUMBING

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING(HVAC)

DIVISION 26 - ELECTRICAL

SECTION A

NOTICE TO BIDDERS - ELECTRONIC BIDDING USING e-BUILDER

1. THE PENNSYLVANIA STATE UNIVERSITY, otherwise known as the University or Owner, invites bids for the following contract:

   Contract No. 1 General Construction

   PSU PROJECT: HB Athletic Fields Bleachers, Press Box and Restroom Building

   PSU PROJECT NUMBER: 00-08713.00

   LOCATED AT: The Pennsylvania State University
   Harrisburg Campus
   Middletown, Pennsylvania

2. BID DATE: Wednesday, May First, Two Thousand Twenty-Four (05/01/2024) at 3:00 p.m. Prevailing Time.

   SUBSTANTIAL COMPLETION DATE: Friday, November First, Two Thousand Twenty-Four (11/01/2024).

   FINAL COMPLETION DATE (completion of all punch list items): Friday, November 22, Two Thousand Twenty-Four (11/22/2024).

3. PREBID CONFERENCE: A Non-Mandatory Prebid Conference will be held at 10:00 AM Prevailing Time, Thursday, March Twenty-Eight, Two Thousand Twenty-Four (03/28/2024), in Room (130) of the Engineering Lab Building, Penn State Harrisburg, Middletown, Pennsylvania.

4. BIDDING DOCUMENTS: Bidding documents must be obtained through the e-Builder Bid Portal. The potential bidder must have, or create, an Account in the Bid Portal. The User Name for your Account is usually your email address.
   Access to the Bid Documents is intended for use by the bidder, their company, and entities involved in formulating the bid response. Distribution of information or documents to plan rooms or websites for the sole purpose of advertising this project is prohibited.

5. Proposals will be received electronically through the e-Builder Bid Portal. **Proposals in any other format will not be accepted.**

   For e-Builder technical support or questions about your user log-in, contact e-Builder directly at 888-288-5717 or email support@e-builder.net

   Non DGS bids will be opened privately. If this is a DGS project, public bid openings must be viewed using a Windows PC due to technical limitations. Use of mobile devices is not supported at this time.

   The online public bid opening can be viewed by web conference at the link located within the project web advertisement.

6. PREQUALIFICATION

Contractors bidding directly to the University for this contract [Prime Contractors] are required to be prequalified in the following prequalification trade category:

- **General Construction**

The following trade Categories of work require University prequalification, whether performed by Subcontractors bidding directly to the Prime Contractor, or if self-performed by the Prime Contractor,:

- Plumbing
- Access Control and Surveillance
- Telecommunications
- Electrical (Med/High Voltage)

Contractors/Sub-Contractors requiring prequalification must be on the *Prequalified Bidders List* as issued by the University at the time of bid. Contractor must submit in writing the names and addresses of all subcontractors requiring prequalification before processing of the first certificate of payment.

Requirements for Prequalification can be found on the Office of the Physical Plant website.

7. BID GUARANTY

A Bid Guaranty in the form of a Certified Check or a Surety Company's Bid Bond shall be submitted as a separate PDF, per instructions with the electronic Proposal, in an amount of not less than five percent (5%) of the total Bid amount.

In the event that any Bidders shall, upon the award of a contract, fail to comply with terms of the Proposal and/or Contract Documents, the amount of the Bid Guaranty shall be forfeited to the Owner.

8. PERFORMANCE AND PAYMENT BONDS

The Contractor, at the time of execution of the Agreement, shall furnish, at its own cost and expense, Performance and Payment Bonds covering the faithful performance of the Contract and the payment of all obligations arising therefrom, each in the full Contract amount and in such form as the Owner may prescribe.

9. BID SUBMITTAL, MODIFICATION, AND REJECTION

By submitting a Bid/Proposal, the Bidder understands and acknowledges that:

The Bid is submitted by a properly authorized officer of the Bidder or their designee who is authorized to sign for the firm, corporation, or individual Bidder.

The Bid amount and price(s) have been arrived at independently and without consultation, communication, or agreement with any other contractor, Bidder, or prospective Bidder.

The Bid as submitted shall hold good through the sixtieth (60th) calendar day following the bid date.

The Bidder, intending to be legally bound hereby, offers and agrees, if its Bid is accepted, to begin work at the site within ten (10) calendar days after the Notice to Proceed, and to complete the work in a thoroughly good and workmanlike manner under the direction of the Professional and to the satisfaction of the Owner, on or before the Completion Dates as stated in the Contract Documents. Furthermore, the Bidder agrees to provide all labor, materials, services, tools, and equipment, and perform all of the required work to complete the contract.

It is the bidder's responsibility to ensure that their bid is received through the Bid Portal on or before the published due date and time.

Your online bid will be assigned a date and time stamp from the eBuilder system which indicates the time of final acceptance. The e-Builder system will not allow submission of an online bid response after the published bid due date and time.

Any bid submitted may be Modified or Withdrawn online, prior to the scheduled time for opening or authorized postponement thereof, using the RECALL BID feature within the e-Builder Bid Package. A Modified bid must be Resubmitted, otherwise, the previous bid remains valid.

Bidders are responsible for ensuring the completeness and scale of documents downloaded and printed from eBuilder before relying on them for as the basis for their bid submission. The bidder is responsible for ensuring that the bid submitted is complete. The bidder is responsible for ensuring that contact information contains a valid email address and that their email settings are set to receive notifications from e-Builder and from the University.

Addenda – Bidders who have created a User Profile in e-Builder will be notified as addenda are issued. When the addendum is issued prior to the bid opening, but AFTER the Bidder submitted their bid, the Bidder will need to resubmit their bid through e-Builder. The Bidder will be required to acknowledge all addenda prior to submitting a bid. All Addenda become part of the Contract Documents.

Questions – The Bidder shall submit all questions, clarifications, bid document discrepancies or omissions via the eBuilder Q&A Board within the Bid Package. Inquiries shall be answered in the form of an Addendum. To receive attention, inquiries must be submitted not later than Noon, Ten (10) days prior to the Bid Date.

The University does not warrant that the e-Builder website or its contents will be uninterrupted or error free and is not responsible for failed receipt and/or delivery of electronic notifications. The University is not responsible for computer download or printing errors.

BEFORE SUBMITTING A PROPOSAL, the Bidder should CAREFULLY EXAMINE the Drawings, Schedules, and Specifications, VISIT THE SITE, fully inform itself as to all laws, ordinances, regulations, wage rates, and labor conditions in the area of operation affecting the Contract or the work, and shall include in his proposal a sum to cover the cost of all items, implied or required, to attain the completed conditions contemplated by the Contract Documents.

THE OWNER DOES NOT OBLIGATE ITSELF to accept the lowest proposal or any proposal, and reserves the right to waive any informalities in any or all bids, and to reject or accept any proposal. Proposals which do not conform to requirements, or which contain additions, conditional bids, or irregularities of any kind, may be rejected.

Bid results will be available at the Owner's convenience.

10. BIDDERS SHALL AGREE, if awarded the Contract for the work, to execute a separate agreement for the work proposed. The Agreement, as a Lump Sum Contract, shall be executed

on the standard Form of Agreement 1-C bound with the Contract Documents.

11. TIME OF COMPLETION--LIQUIDATED DAMAGES. Contractor must agree to begin work contemplated by this contract within ten (10) days after the date specified in the Notice to Proceed as the starting date and to complete the work on or before Friday, November one, two thousand twenty-four (11/01/2024) subject to extension of Contract time as provided in Article 10 of the General Conditions. Contractor must agree to pay to the Owner as liquidated damages and not as a penalty, the sum of **zero** Dollars $0.00 per calendar day for each calendar day of delay. The Contractor and its surety shall be liable for the amount thereof.

12. Local Building Permit costs shall not be included in the Contract Amount.

13. TO VISIT THE SITE, contact Dan Barlup

TELEPHONE: (717) 948-6235

14. EQUAL EMPLOYMENT OPPORTUNITY AND REFERRAL TO NON-DISCRIMINATION CLAUSE

Contractor shall not discriminate against any employee, applicant for employment, any independent Contractor or any other person because of race, color, religious creed, ancestry, national origin, service in the uniformed services (as defined in state and federal law), veteran status, age, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas, or any other basis prohibited by law.

In performing the work or making or furnishing any article required by this Contract, the Contractor shall comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended by Executive Order No. 11375 of October 13, 1967, and all subsequent rules, regulations, and relevant orders of the Secretary of Labor. The Contractor will comply with all provisions of Executive Order 1972-1 or any regulations issued by the Pennsylvania Human Relations Commission, 16 Pa. Code, Chapter 49. The Non-Discrimination Clause as issued by the Pennsylvania Human Relations Commission is attached as Article 13 of the General Conditions of the Contract.

15. PREVAILING WAGE ACT

This project is subject to the Pennsylvania Prevailing Wage Act, Act No. 442, August 15, 1961 (P.L. 987), as amended August 9, 1963, Act No. 342. All Contractors and Subcontractors shall comply with all requirements of this Act. Refer to Sections D and D1 of this specification for additional information.

16. STEEL PRODUCTS PROCUREMENT ACT

A. This project is subject to the provisions of the Steel Products Procurement Act of 1978 (P.L. 6, No. 3) as amended by the Act of July 9, 1984 (P.L. 674, No. 144). All Contractors, Subcontractors, and Material Suppliers shall be required to comply with all provisions of this Act.

B. The Contractor shall be required to provide with each Application-Certificate of Payment form an executed copy of the Certification of Compliance with the Steel Products Procurement Act form **and additional documentation**, including but not limited to, invoices, bills of lading, mill certifications, or other acceptable evidence that the steel products represented on the payment application comply with one or more of the following categories:

(1) That the steel utilized on this project was melted and manufactured in the United States; and/or

(2) The product contains both foreign and United States steel, and at least seventy-five percent (75%) of the cost of all of the articles, materials, and supplies incorporated in the product have been mined, produced, or manufactured, as the case may be, in the United States; and/or

(3) The steel product is not produced in the United States in sufficient quantities to meet the requirements of the contract, and prior written approval to use foreign steel has been obtained from The Pennsylvania State University.

C. Any nonconforming steel products incorporated into the work shall be removed and replaced by the Contractor, at its own expense, with products meeting the requirements of the Act.

D. Willful violation of this Act can result in penalties, including (but not necessarily limited to) prohibition from submitting any bids, or performing any work, or supplying any materials to a public agency for a period five (5) years from the date of the determination that a violation has occurred.

17. All work relating to this project shall be subject to all federal, state and local codes, ordinances and regulations regarding occupational safety and health, environmental protection and construction standards. Nothing contained in the specifications or the drawings shall be construed to conflict with such laws, codes, ordinances or regulations, and in the event of such conflict any requirement imposed by law, ordinance or regulation shall be deemed controlling.

18. Intentionally left blank.

19. LEAD-FREE PLUMBING CERTIFICATION
The Contractor shall provide a certification that all plumbing materials are lead-free and meet the requirements of the Pennsylvania Plumbing and Lead Ban Notification Act. This certification shall be signed by the Contractor, notarized and submitted to the University before the water service turn-on.

20. DIVERSE BUSINESS ENTERPRISES

A. The University recognizes the following groups as Diverse Business Enterprises:
- Minority Business Enterprises (MBE)
- Women Business Enterprises (WBE)
- Lesbian, Gay, Bisexual, & Transgender (LGBT)
- Veteran & Service Disabled Veteran Owned Businesses (VOB/SDVOB)

B. The Owner's goal is for 10% combined utilization of Diverse Business Enterprise (DBE) contractors and suppliers on all projects unless otherwise noted. For Construction Manager or Design-Build projects, the DBE combined utilization goal is 15% minimum.

C. The University recognizes DBE contractor and supplier certifications granted to firms by any of the following agencies:

- Department of General Services Bureau of Small Business Opportunities (BSBO)
- Federal Department of Transportation
- National Minority Development Council (NMSDC) or its affiliates
- Southeastern PA Transportation Authority (SEPTA)
- Women Business Enterprise National Counsel (WBENC)
- Pennsylvania Unified Certification Program (PA UCP)
- Pennsylvania Department of Transportation (Penn DOT)
- National Women Business Owners Corporation (NWBOC)
- Minority Business Enterprise Council (MBEC)
- National Gay and Lesbian Chamber of Commerce (NGLLC)
- U.S. Department of Veteran Affairs (VOB/SDVOB)

The University reserves the right to revise this list at its own discretion.

D. DBE utilization will be scored as part of the project Contractor Evaluation. Failure to meet the Owner's expected goal will result in a below-average score in the DBE utilization section. Repeated failure to meet DBE goals may result in removal from the University's Prequalified Bidder's List.

E. The Contractor is responsible to submit DBE utilization reports to the OPP Contractor Liaison upon request, identifying all DBE contractors and suppliers associated with the project including their original contract amount and change orders.

F. **The DBE Contractor/Supplier Utilization Bid Form (EXHIBIT A) is REQUIRED AT TIME OF BID.**

G. The University's Diverse Business Utilization Report is required to be submitted with each payment application, identifying all DBE contractors and suppliers associated with the project, including their original Contract amount and change orders. The Bidder understands that Payment on this contract will not be processed until DBE Utilization data is submitted to University.

H. If there is no anticipated participation of DBE's on this project, a justification letter must be submitted prior to the execution of the contract for University review.

21. BACKGROUND CHECK POLICY(HR99)

The awarded Contractor will be required to confirm through the execution of the contract that all employees (including the employees of any subconsultants/subcontractors) assigned to this project and who conduct their work on University premises have had background checks that meet or exceed the University's standards for the type of work being performed per the background check process for third-party employees outlined in the University's Policy HR99 Background Check.

22. SMOKING AND TOBACCO POLICY

Smoking and the use of tobacco are prohibited in and on all University owned or leased properties, facilities, and vehicles, per University Policy AD 32.

23. PUBLIC WORKS EMPLOYMENT VERIFICATION ACT

The Commonwealth of PA enacted Act 127 of 2012, requiring all public works contractors and subcontractors to utilize the Federal Government's E-Verify system, operated by the United States Department of Homeland Security, to ensure that all employees of firms performing work on public work projects are authorized to work in the United States.

The Contractor, as a pre-condition of award, will be required to comply with this Act. The Contractor will submit, to the Owner, the Commonwealth of PA 'Public Works Employment Verification Form' found on the Pennsylvania Department of General Services web site: https://www.dgs.pa.gov/Design-and-Construction/Bidding/Documents/Public%20Works%20Employment%20Verification%20Form.pdf

The Contractor shall also confirm current compliance with the Act; Ensure that all subcontractors are in compliance and submit the appropriate E-Verification Forms prior to starting work; And confirm continuation of compliance by verifying the employment of all new employees of the Contractor and Subcontractors within five(5) days of their respective start dates.

24. SOCIAL RESPONSIBILITY/ CONTRACTOR CONDUCT

A. Fulfilling the mission of The Pennsylvania State University for those we serve requires the highest standards of integrity, responsibility, and respect, and we encourage our contractors/suppliers to aspire to those same standards, particularly when on campus or engaging with members of the University community. The University has adopted the Global Sullivan Principles of Social Responsibility. We also encourage our contractors/suppliers to adopt and follow these principles.

B. The University is committed to equal access to programs, facilities, admission and employment for all persons, in an environment free of harassment and free of discrimination. Conduct constituting harassment or discrimination in the University environment, as prohibited in University Policy AD85, is subject to corrective action.

25. ELECTRONIC PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

The Owner has implemented an electronic PMIS, "e-Builder", an internet-based information and project communication system that will allow the entire project team to collaborate in a centralized and secured repository for all projects.

The Contractor shall utilize the PMIS during all phases of the project, unless directed otherwise by the Owner. All project specific correspondence, workflow processes, and documentation will be stored and routed within the PMIS. The Contractor and the Owner shall agree on file name convention of submissions in advance.

The Contractor, or those direct-employee(s) responsible, on each project will be expected to participate in the necessary training to use the PMIS effectively. Periodic training sessions on the PMIS will be provided by the Owner. Registration will be through the University's Learning Resource Network (LRN). It is the responsibility of the Contractor to coordinate with the Owner regarding the training schedule and to register via the LRN. All costs for personnel time, travel, meals, and lodging to attend the training shall be borne by the Contractor and, as such, will not be reimbursed by the Owner.

The Contractor shall obtain, at their own cost, the necessary equipment and web connections to access and utilize the PMIS. The Contractor will not incur any registration fees or licensing costs to utilize the PMIS.

The Owner will not entertain or acknowledge any amendment requests by the Contractor for claimed inefficiencies or other costs related to the implementation and subsequent use of the PMIS.

DBE Contractor/Supplier Utilization Form

1. This document shall be completed in its entirety and **FURNISHED with the BID.** The Contractor's bid amount shall include utilization of certified minority and/or women owned businesses to the extent possible certified by one of the following entities: Department of General Services Bureau of Minority & Women Business Opportunities (DGS BMWBO), Federal Department of Transportation, National Minority Development Council (NMSDC) or its affiliates, Southeastern PA Transportation Authority (SEPTA), Women Business Enterprise National Council (WBENC), Pennsylvania Unified Certification Program (PA UCP), Pennsylvania Department of Transportation (Penn DOT), National Women Business Owners Corporation (NWBOC), Minority Business Enterprise Council (MBEC), National Gay and Lesbian Chamber of Commerce (NGLLC), and U.S. Department of Veteran Affairs.

2. The information contained herein shall remain confidential and shall be shared with the Owner and Owner's representative only.

3. The Owner DBE goal is 10% when Penn State holds the trade contract. When Trade Contracts are held by the CM or DB, the DBE goal is 15% or more.

DBE Name	Contact Name & Phone No.	Check (X) DBE Designation				Check (X) DBE Designation		Description of Work	Projected Contract $ Amount
		MBE	WBE	LGBT	VOB	Contractor	Supplier		
1.									$
2.									$
3.									$
4.									$
5.									$
6.									$
7.									$
8.									$
9.									$
10.									$
									$

FORM OF AGREEMENT 1-C

THE PENNSYLVANIA STATE UNIVERSITY
OWNER AND CONTRACTOR
CONTRACT

THIS AGREEMENT, with effective date being the date of the last signature below, is made by and between:

«ProcessFields_CompanyNamenoCarat»
«Company_Address»
«City», «State» «Zip»

hereinafter called the Contractor and THE PENNSYLVANIA STATE UNIVERSITY, a state-related institution and instrumentality of the Commonwealth of Pennsylvania subject to the Pennsylvania nonprofit corporation laws (hereinafter called the "Owner" for the following project):

Project Number: «ProjectCustom_ProjectNumber»
Project Name: «Project_Name»
Campus Location: «ProjectCustom_Campus»
County: «ProcessFields_County»
Building Name/Number: «ProjectCustom_Building»

In consideration of the promises set forth herein, and with intent to be legally bound, the parties agree as follows:

ARTICLE 1: THE WORK AND THE DOCUMENTS FORMING THE CONTRACT

The Work forming the subject of this _____

_____ Construction Contract is shown on Drawings titled:

_____

_____

_____

_____

_____

_____

_____

_____

It is described in the Specification, consisting of the General Conditions of the Contract, Articles 1 to 16 inclusive and Prevailing Wage Serial Number: «ProcessFields_PrevailingWageSerialNumber», dated «ProcessFields_PrevailingWageDeterminatio»

The said Drawings and Specifications together with the General Conditions, as hereinabove described, are as fully a part hereof as if hereto attached or herein repeated.

ARTICLE 2: THE PROFESSIONAL

References to the Professional in any of the Contract Documents shall refer to the Professional whose name appears hereafter:

Professional (A/E): «ProcessFields_DesignerName»

The Professional shall either be a person or firm lawfully licensed to practice architecture or engineering or the appropriate office of the Owner as noted.

ARTICLE 3: THE CONTRACTOR'S DUTIES AND STATUS

The Contractor agrees to furnish the labor, material, tools, machinery, equipment, facilities, and supplies to do all things necessary for the construction and completion of the Work; to furnish efficient business administration and superintendence; to have at the Work whenever needed and to keep upon it at all times an adequate supply of workmen and materials, and to secure its execution in the best, most workmanlike, expeditious and economical manner.

The Contractor, recognizing the relations of trust and confidence established between the Contractor and the Owner by the terms of this Agreement, undertakes to furnish its best skill and judgment and to cooperate loyally with the Professional in forwarding the interests of the Owner, and to have no pecuniary interest, direct or indirect, in the Contract or in its performance other than as disclosed in this Agreement.

ARTICLE 4: OWNER'S REPRESENTATION

The Owner shall appoint a representative who shall act for the Owner in the execution of this Contract.

ARTICLE 5: CONTRACT SUM

In consideration of the completion by the Contractor of the Work contemplated in this Contract in strict accordance therewith, the Owner agrees to pay to the Contractor the sum of «r *DollarText*Upper», Dollars «Commitment_OriginalCommitmentValue», which sum is not to be increased or diminished except as provided in Article 9 of the General Conditions relative to Changes in the Work.

#	Description	Amount
«S» « »	«ProcessDynamicGrid_Construction_Contract»	«»«End»

Unit Prices:
Unit Price Description: «ProcessFields_UnitPriceDescription»

ARTICLE 6: PAYMENTS

Payment information is referenced in Article 11 of the General Conditions of the Contract,.

ARTICLE 7: LIENS/PERFORMANCE BOND

Notwithstanding and in addition to the provisions relative to liens set forth in Paragraph 11.8 of the General Conditions of the Contract, the parties hereto have executed a Waiver of Liens/Stipulation Against Liens Agreement, and Contractor has purchased a payment bond which shall serve as a guarantee of payment for the work, services, labor, materials and/or equipment provided by any and all subcontractors. Contractor hereby specifically waives all lien rights of subcontractors, as that term is defined under the Pennsylvania Mechanics' Lien Law of 1963. Contractor hereby covenants, promises and agrees that no mechanics' or materialmen's lien or claim, or any other lien or claim, will be filed or maintained on the Property, or any grounds or curtilages appurtenant thereto, or any other structure or property owned by the Owner, either by Contractor or any subcontractor, for or on account of any work, labor or materials supplied by any subcontractor in the performance of the Contract, or under any supplemental contract for extra work, in the erection, construction or completion of the improvements to the Property.

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.1 Applicable Law

The interpretation and construction of this Agreement shall be governed by the laws of the Commonwealth of Pennsylvania. In the event litigation arises out of this contract, the parties agree to submit any claim to the competent courts of Centre County, Pennsylvania.

8.2 Successors and Assigns

This Agreement shall be binding on the successors and assigns of the parties hereto.

8.3 Assignment

Neither the Owner nor the Contractor shall assign, sublet or in any manner transfer any right, duty, or obligation under this Agreement without prior written consent of the other party.

8.4 Release of Information

The Contractor understands and agrees that the Owner may release to taxing authorities any and all information relating to the Work.

8.5 Background Check Policy

The Contractor confirms that all employees (including the employees of any subconsultants/subcontractors) assigned to this project and who conduct their work on Penn State premises have had background checks that meet or exceed the University's standards for the type of work being performed per the background check process for third-party employees outlined in PSU Policy HR99 Background Check Process.

8.6 Public Works Employment Verification Act

As a precondition to the award of the contract for the Work described herein, Contractor must complete the Commonwealth of Pennsylvania 'Public Works Employment Verification Form' ("Form") and provide a copy to Owner.

Furthermore, by execution of this Agreement, the Contractor hereby affirms as follows:

A. Contractor is presently and shall remain in compliance with the Pennsylvania Public Works Employment Verification Act ("the Act") through utilization of the Federal E-Verify Program ("EVP") operated by the United States Department of Homeland Security.

B. Contractor will ensure that all contracts with subcontractors contain notification of the applicability of the Act, information regarding the use of EVP, and either a copy of the Form or a reference to the Pennsylvania Department of General Services website at www.dgs.state.pa.us , where the Form may be obtained. Contractor will further ensure that prior to beginning onsite or offsite work, every subcontractor shall submit a completed Form to the Owner.

C. Contractor and subcontractors shall utilize EVP to verify the employment eligibility of each new employee hired, whether the new employee will be performing onsite or offsite work, within five (5) business days of the employee's start date and shall maintain documentation of continued compliance with the Act for the duration of this Agreement.

D. Contractor and subcontractors shall cooperate with Owner and Pennsylvania Department of General Services in the event of an audit arising under the Act.

8.7 Social Responsibility / Contractor Conduct

A. Fulfilling the mission of The Pennsylvania State University for those we serve requires the highest standards of integrity, responsibility, and respect, and we encourage our contractors/suppliers to aspire to those same standards, particularly when on campus or engaging with members of the University community. The University has adopted the Global Sullivan Principles of Social Responsibility. We also encourage our contractors/suppliers to adopt and follow these principles.

B. The University is committed to equal access to programs, facilities, admission and employment for all persons, in an environment free of harassment and free of discrimination. Conduct constituting harassment or discrimination in the University environment, as prohibited in University Policy AD85, is subject to corrective action.

THIS AGREEMENT entered into as of the day and year of the last signature below.

«PROCESSFIELDS_COMPANYNAMENOCARAT»
CONTRACTOR

By:_____
Signature

Name:_____
(Please print name of person signing above)

Title:_____
(Please print title of person signing above)

Date of Signature/Execution: _____

THE PENNSYLVANIA STATE UNIVERSITY
OWNER

By:_____
Signature

Name:_____
(Please print name of person signing above)

Title:_____
(Please print title of person signing above)

Date of Signature/Execution: _____

GENERAL CONDITIONS OF THE CONTRACT

THE PENNSYLVANIA STATE UNIVERSITY

SCHEDULE OF ARTICLES

Article 1 GENERAL CONTRACT DEFINITIONS

1.1 THE CONTRACT DOCUMENTS

1.1.1 The Contract Documents consist of the Form of Agreement 1-C or Form of Agreement DGS 1-C, hereinafter called the Agreement, General Conditions of the Contract, Drawings, Specifications, Addenda issued prior to receipt of bids, Form of Proposal, other documents listed in the Agreement, and those modifications to the Contract as follows:

1.1.2 Owner's written authorization to the Contractor for changes to the Work

1.1.3 Change Order

1.1.4 A written order for a minor change in the Work issued by the Professional

1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes all prior negotiations, representations, or agreements either written or oral.

The Contract may be amended only by those modifications described in Paragraph 1.1.

1.3 OWNER

The Owner is The Pennsylvania State University, a corporation created and existing under the laws of the Commonwealth of Pennsylvania, hereinafter called the Owner, and shall mean the Owner or the Owner's authorized representative.

1.4 PROFESSIONAL

The Professional is the person lawfully licensed to practice architecture or engineering, or the firm employed to provide architectural or engineering services. The term "Professional" shall mean the Professional or the Professional's authorized representative.

1.5 CONTRACTOR

The Contractor is the individual, corporation, company, partnership, firm, or other organization that has contracted to perform the Work under the Agreement with the Owner. The term "Contractor" shall mean the Contractor or the Contractor's authorized representative.

1.6 SUBCONTRACTOR

A Subcontractor is a person or organization who contracts under, or for the performance of part or all of, the Contract between the Owner and the Contractor. The subcontract may be direct with the Contractor or with another Subcontractor. The term "Subcontractor" shall mean the Subcontractor or the Subcontractor's authorized representative.

1.7 THE WORK

The term "Work" shall mean whatever is done by or required of the Contractor to perform and complete its duties under this Contract, including the following: construction of the whole or a designated part of the Project; furnishing of any required surety bonds and insurance; and the provision or furnishing of labor, supervision, services, materials, supplies, equipment, fixtures, appliances, facilities, tools, transportation, storage, power, permits and licenses required of the Contractor, fuel, heat, light, cooling and all other utilities as required by this Contract.

1.8 THE PROJECT

The term "Project" shall comprise the Work defined by the Contract Documents and may include Work by the Owner or other Separate Contractors, or the Professional.

1.9 THE DRAWINGS

The Drawings are the graphic portion of the Contract Documents generally consisting of plans, elevations, sections, details, diagrams, and schedules of the Work.

1.10 THE SPECIFICATIONS/PROJECT MANUAL
The Specifications are the written portion of the Contract Documents generally outlining the requirements for materials, equipment, construction systems, methods, standards, workmanship, and performance necessary to properly complete the Work.

The Project Manual is the document assembled consisting of all the written portions for the Work including the Specifications, bidding requirements, sample forms, General Conditions and Special Requirements.

1.11 DAY
Whenever the word "day" is used in the Contract Documents, it shall be interpreted to mean a calendar day unless otherwise noted.

1.12 THE CONTRACT SUM
The Contract Sum is the total compensation payable to the Contractor for performing the Work as specified in the Contract Documents or subsequently adjusted by modification to the Contract.

1.13 CLAIM
A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

1.14 SCOPE OF WORK
All Work reasonably contemplated, required, implied or reasonably inferable by the Contract Documents, whether or not explicitly contained in the Contract Documents.

1.15 SUBSTANTIAL COMPLETION
"Substantial Completion" shall mean that stage in the progression of the Work when the Work is sufficiently complete in accordance with this Contract that the Owner can enjoy beneficial use or occupancy of the Work and can utilize the Work for its intended purpose.

1.16 ELECTRONIC PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)
The Owner has implemented an electronic PMIS, “e-Builder”, an internet-based information and project communication system that will allow the entire project team to collaborate in a centralized and secured repository for all projects.

Article 2 CONTRACT DOCUMENTS

2.1 OWNERSHIP AND USE OF DOCUMENTS
All Drawings, Specifications and other documents of the Work furnished by the Professional are and shall remain the Professional's property. They are not to be used by the Contractor on other projects without written consent of the Owner and the Professional.

2.2 COPIES FURNISHED - DRAWINGS AND SPECIFICATIONS
The Professional will furnish to the Contractor, free of charge, three copies of Drawings and Specifications for the execution of the Work. The Drawings will be prints on paper, unmounted. Any additional copies of the Drawings and Specifications which the Contractor may desire will be furnished at the cost of reproduction and delivery.

2.3 DRAWINGS AND SPECIFICATIONS AT THE SITE
The Contractor shall maintain at the site one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Product Data, Samples and Contract Modifications, in good order and marked to record all changes made during construction.

2.4 AS-BUILT AND RECORD DRAWINGS
The Contractor shall, at the time of substantial completion of the Work, deliver to the Professional the complete set of as-built drawings. The Professional will, within 30 days after receipt from the Contractor, transpose all changes recorded by the Contractor onto a full set of reproducible

drawings, and CADD electronic media, compatible with the Owner's CADD system, which shall become the record drawings for the Project, and shall forward same to the Owner. A copy in CADD format compatible with the Owner's CADD system and a copy in .pdf format shall be forwarded to the Owner by the Professional. If Building Information Modeling is utilized on the project an additional alternate form of as-built/record drawings may be required to be submitted by both the Professional and Contractor.

2.5 INTERRELATIONSHIP AND INTENT OF DOCUMENTS

2.5.1 The intent of this Contract is to require complete, correct, and timely execution of the Work. Any Work that may be required, implied, or inferred by the Contract Documents, or any one or more of them, as necessary to produce the intended result shall be provided by the Contractor for the Contract Price.

2.5.2 This Contract is intended to be an integral whole and shall be interpreted as internally consistent. What is required by any one Contract Document shall be considered as required by the Contract.

2.5.3 When a word, term, or phrase is used in this Contract, it shall be interpreted or construed, first, as defined herein; second, if not defined, according to its generally accepted meaning in the construction industry; and third, if there is no generally accepted meaning in the construction industry, according to its common and customary usage.

2.5.4 The words "include," "includes," or "including," as used in this Contract, shall be deemed to be followed by the phrase, "without limitation."

2.5.5 The specification herein of any act, failure, refusal, omission, event, occurrence, or condition as constituting a material breach of this Contract shall not imply that any other, non-specified act, failure, refusal, omission, event, occurrence, or condition shall be deemed not to constitute a material breach of this Contract.

2.5.6 Words or terms used as nouns in this Contract shall be inclusive of their singular and plural forms unless the context of their usage clearly requires a contrary meaning.

2.5.7 The Contractor shall have a continuing duty to read, carefully study and compare each of the Contract Documents, the Shop Drawings, and the Product Data and shall give written notice to the Owner of any inconsistency, ambiguity, error, or omission which the Contractor may discover with respect to these documents before proceeding with the affected Work. The issuance, or the express or implied approval by the Owner or the Professional of the Contract Documents, Shop Drawings, or Product Data shall not relieve the Contractor of the continuing duties imposed hereby, nor shall any such approval be evidence of the Contractor's compliance with this Contract. The Owner has requested the Professional to only prepare documents for the Project, including the Drawings and Specifications for the Project, which are accurate, adequate, consistent, coordinate, and sufficient for construction. HOWEVER, THE OWNER MAKES NO REPRESENTATION OR WARRANTY OF ANY NATURE WHATSOEVER TO THE CONTRACTOR CONCERNING SUCH DOCUMENTS. By the execution hereof, the Contractor acknowledges and represents that it has received, reviewed, and carefully examined such documents, has found them to be complete, accurate, adequate, consistent, coordinated, and sufficient for construction, and that the Contractor has not, does not, and will not rely upon any representation or warranties by the Owner concerning such documents as no such representation or warranties have been or are hereby made.

2.5.8 Neither the organization of any of the Contract Documents into divisions, sections, paragraphs, articles, (or other categories), nor the organization or arrangement of the Design, shall control the Contractor in dividing the Work or in establishing the extent or scope of the Work to be performed by Subcontractors.

2.5.9 The interrelation of the Drawings, the Specifications and the schedules is as follows:

2.5.9.1 The Drawings establish the quantities, dimensions, and details.

2.5.9.2 The Specifications determine the nature and installation of the various materials and equipment.

2.5.9.3 The schedules give the locations.

2.5.9.4 The Drawings and Specifications are complementary and what is required by one shall be as binding as if shown or mentioned in both.

2.5.9.5 Should the Drawings disagree with one another, or with the Specifications, the better quality or greater quantity of Work or materials shall be performed or furnished.

Dimensions given on Drawings govern small scale Drawings. Dimensions given on Drawings govern scale measurements, and large-scale details govern small scale drawings. In case of discrepancy in the Dimensions, in the Drawings, in the schedules, or in the Specifications, the matter shall be promptly submitted to the Professional who will promptly make a determination, after advice and consent of the Owner, in writing.

2.5.10 The "Scope of the Work," usually placed in the front part of each Section of the Specifications, is intended to designate the scope and locations of all items of the Work included therein, either generally or specifically. It is not intended to limit the Scope of Work should plans, schedules or notes indicate an increased scope. Inadvertent omission of an item from its proper section of the Specifications and its inclusion in another section shall not relieve the Contractor of responsibilities for the item specified.

Article 3 INSURANCE

3.1 CONTRACTOR'S INSURANCE

3.1.1 Before commencing the Work and as a condition precedent to payment, the Contractor shall procure and maintain the following insurance, in amounts not less than that specified for each type:

3.1.1.1 Workers' Compensation for statutory obligations imposed by workers' compensation and occupational disease laws. Employers' Liability insurance shall be provided with limits not less than:

a) $500,000 bodily injury by accident per accident
b) $500,000 bodily injury by disease policy limit
c) $500,000 bodily injury by disease per employee

3.1.1.2 Business Automobile Liability (bodily injury liability and property damage liability) for all owned, leased, hired, non-owned vehicles with limits not less than $1,000,000 Combined Single Limit.

3.1.1.3 Commercial General Liability insurance including coverage for bodily injury, property damage, and personal and advertising injury, for premises and operations, products and completed operations, and contractual liability arising from all operations, written on an occurrence basis with limits not less than:

<u>FOR PROJECTS UNDER $1,000,000</u>

a) Per occurrence: $1,000,000
b) General aggregate: $2,000,000
c) Products/completed operations aggregate: $2,000,000
d) Personal and advertising injury limit: $1,000,000
e) Medical Expense Limit: $10,000

The Contractor shall maintain completed operations liability insurance for not less than one year after Substantial Completion, or as required by the Contract Documents, whichever is longer.

<u>FOR PROJECTS OVER $1,000,000</u>

a) Per occurrence: $5,000,000
b) General aggregate: $5,000,000
c) Products/completed operations aggregate: $5,000,000
d) Personal and advertising injury limit: $5,000,000
e) Medical Expense Limit: $10,000

The Contractor shall maintain completed operations liability insurance for

not less than two years after Substantial Completion, or as required by the Contract Documents, whichever is longer.

3.1.2 Professional Liability insurance: Where professional services are being provided by licensed and non-licensed professionals, the Contractor shall obtain, either itself or through the Design Professional, professional liability insurance for claims arising from the negligent performance of professional services under this Agreement (including, but not limited to, acts, errors, or omissions of the company and its employees), which shall be written for not less than One Million dollars ($1,000,000) or the total of the Design Fee portion of the Contract, whichever is greater, per claim and in the aggregate. The Professional Liability insurance shall include prior acts coverage sufficient to cover all services rendered by the Contractor. This coverage shall be continued in effect for 3 year(s) after the Date of Substantial Completion.

3.1.2.1 Pollution Liability insurance: If the nature of the Work involves professional services, evaluating, testing, remediation, abatement, removal, storage, and transportation of hazardous materials or substances or pollutants, the Contractor and those Subcontractors involved in such work shall obtain Pollution Liability insurance applicable to their work, for bodily injury and property damage with limits not less than:

FOR PROJECTS UNDER $1,000,000
a) Per occurrence or claim: $1,000,000
b) Aggregate: $1,000,000

FOR PROJECTS OVER $1,000,000
a) Per occurrence or claim: $5,000,000
b) Aggregate: $5,000,000

The Pollution Liability insurance must include coverage for completed operations extending three (3) years after final acceptance of the project by the owner or such longer period as the contract documents may require. The definition of property damage shall include clean-up costs. If the insurance is written on a claims-made basis, the policy retroactive date shall be prior to the start of the Contractor's/supplier's/vendor's work, and the renewal policies shall maintain the same retroactive date.

3.1.3 The insurance limits required for the Employers' Liability, Business Automobile Liability and CGL coverage required under subsection 3.1.1 may be provided by a combination of primary and Excess or Umbrella Liability policies.

3.1.4 The Owner must be named on the Contractor's Commercial General Liability insurance as an additional insured.

3.1.5 The Contractor shall maintain in effect all insurance coverage required under Article 3 with insurance companies lawfully authorized to do business in the jurisdiction in which the Project is located.

3.1.6 If the Contractor fails to obtain or maintain any insurance coverage required under this Agreement, the Owner may purchase such coverage and charge the expense to the Design-Builder or terminate this Agreement.

3.1.7 Insurance policies required under subsection 3.1 shall contain a provision that the insurance company or its designee must give the Owner written notice transmitted in paper or electronic format: (a) 30 days before coverage is non-renewed by the insurance company and (b) within 10 business days after cancelation of coverage by the insurance company.

3.1.8 Prior to commencing the Work and upon renewal or replacement of the insurance policies, the Contractor shall furnish the Owner with certificates of insurance until one year after Substantial Completion or longer if required by the Contract Documents. In addition, if any insurance policy required under subsection 3.1 is not to be immediately replaced without lapse in coverage when it expires, exhausts its limits, or is to be cancelled, the Contractor

shall give Owner prompt written notice upon actual or constructive knowledge of such condition.

3.1.9 The Contractor's insurance shall be primary and non-contributory to the University's insurance.

3.1.10 Failure of the Contractor to procure, carry, and maintain the required insurance shall not relieve the Contractor, and any Subcontractor thereof, of any obligation or liability assumed under this Agreement, nor of any obligation or liability imposed by law.

3.1.11 Any self-insured retentions, deductibles, and exclusions in coverage in the insurance required shall be assumed by and at the sole risk of the Contractor.

3.2 PROPERTY INSURANCE

3.2.1 Before commencing the Work, the Owner shall obtain and maintain a Builder's Risk Policy Insurance upon the entire Project for the full cost of replacement at the time of loss. In addition to the Owner this insurance shall also name the Contractor, Subcontractors, Sub-subcontractors, Material Suppliers and/or Design-Professional as named insureds. This insurance shall be written as a Builder's Risk Policy or equivalent form to cover risks of physical loss except those specifically excluded by the insurance policy, and shall insure (a) at least against the perils of fire, lightning, explosion, windstorm, hail, smoke, aircraft (except aircraft, including helicopter, operated by or on behalf of Contractor) and vehicles, riot and civil commotion, theft, vandalism, malicious mischief, debris removal, flood, earthquake, earth movement, water damage, wind damage, testing if applicable, collapse however caused, and (b) damage resulting from defective design, workmanship or material and material or equipment stored offsite, onsite or in transit. This insurance policy shall provide for a waiver of subrogation in favor of the named insureds. This insurance shall remain in effect until final payment has been made or until no person or entity other than the Owner has an insurable interest in the property to be covered by this insurance, whichever is sooner. Partial occupancy or use of the Work shall not commence until the Owner has secured the consent of the insurance company or companies providing the insurance coverage required in this subsection. Before commencing the Work, the Owner shall provide a copy of the property policy or policies obtained in compliance with this subsection.

3.2.1.1 The Builder's Risk property insurance has a deductible. If the Contractor suffers a Builders Risk loss covered by this insurance, the Contractor shall be responsible for the first $25,000 of such deductible. If the Owner or insurer increases the required minimum deductibles above the amounts so identified or if the Owner elects to purchase this insurance with voluntary deductible amounts, the Owner shall be responsible for payment of the additional costs not covered because of such increased or voluntary deductibles. Contractor's payment towards the deductible of a loss covered by this insurance will not exceed $25,000 per occurrence.

3.2.2 If the Owner does not intend to purchase the property insurance required by this Agreement, including all the coverages and deductibles described herein, the Owner shall give written notice to the Contractor and the Design-Professional before the Work is commenced. The Contractor may then provide insurance to protect its interests and the interests of the Subcontractors and Sub-subcontractors, including the coverage of deductibles. The cost of this insurance shall be charged to the Owner in a Change Order. The Owner shall be responsible for all of Contractor's costs reasonably attributed to the Owner's failure or neglect in purchasing or maintaining the coverage described above.

3.2.2.1 If the Owner does not obtain insurance to cover the risk of physical loss resulting from Terrorism, the Owner shall give written notice to the Contractor before the Work commences. The Contractor may then provide insurance to protect its interests and the interests of the Subcontractors and Sub-subcontractors against such risk of loss, including the coverage of deductibles. The cost of this insurance shall be charged to the Owner in a Change Order.

3.2.3 Owner and Contractor waive all rights against each other and their respective employees, agents, contractors, subcontractors and sub-subcontractors, and design professionals for damages caused by risks covered by the property insurance except such rights as they may have to the proceeds of the insurance and such rights as the Contractor may have for

the failure of the Owner to obtain and maintain property insurance in compliance with subsection 3.2.1.

3.2.4 RISK OF LOSS Except to the extent a loss is covered by applicable insurance, risk of loss or damage to the Work shall be upon the Contractor until the Date of Substantial Completion, unless otherwise agreed to by the Parties.

3.3 OWNER'S INSURANCE

3.3.1 Business Income Insurance: The Owner may procure and maintain insurance against loss of use of the Owner's property caused by fire or other casualty loss.

3.3.2 Owner's Liability Insurance: The Owner shall maintain its own liability insurance for protection against claims arising out of the performance of this Agreement, including loss of use and claims, losses and expenses arising out of the Owner's acts or omissions.

Article 4 GOVERNING LAWS

4.1 GOVERNING LAW

The Contract shall be governed by the law of the Commonwealth of Pennsylvania. In the event litigation arises out of this Contract, the parties agree to submit any claim to the competent courts of Centre County, Pennsylvania.

4.2 COMPLIANCE WITH LAWS

The Contractor always shall observe and comply with all Federal, State and Local laws, by-laws, ordinances, codes, and regulations, in any manner affecting the conduct of the Work or applying to any employees on the Project, as well as all orders or decrees which have been promulgated or enacted, or which may be promulgated or enacted during the progress of the Work, by any legal bodies or tribunals having authority or jurisdiction over the Work, materials, employees or the Contract.

Contractor shall indemnify and save harmless the Owner and all its officers, employees and agents from all suits, actions, or claims of any character or description brought for, made on account of, or arising from the violation of any such law, by-law, ordinance, regulation, order, or decree.

4.3 PREVAILING WAGE ACT

The Contractor is hereby notified that this Contract is subject to the provisions, duties, obligations, remedies and penalties of the Pennsylvania Prevailing Wage Act, Act No. 442, August 15, 1961 (P.L. 987), and as amended August 9, 1963, Act No. 342; and said Act is incorporated herein by reference as fully as though the same were here set forth at length.

4.4 TAXES

The Contractor shall pay sales, consumer, use and similar taxes for the Work on portions thereof provided by the Contractor which are legally enacted when bids are received, whether or not yet effective or merely scheduled to go into effect.

The Contractor is obligated to pay all Pennsylvania sales tax with the exception of those items for which an exemption might be claimed under Sales and Use Tax Regulation 150 (S31.11--SS31.16).

The Contractor shall agree to assign and transfer to the Owner all its rights to sales and use tax which may be refunded as a result of a claim for refund for material purchased in connection with this contract. The Contractor further agrees that is will not file a claim for refund for any sales or use tax which is the subject of this assignment. The Contractor shall incorporate this Owner’s right to any and all Subcontracts.

4.5 ROYALTIES AND PATENTS

The Contractor shall pay all royalties and license fees, and defend all suits or Claims for infringement of any patent rights and shall save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such royalties and license fees and loss when a particular design or process, or the product of a particular manufacturer or manufacturers is specified; provided, however, if the Contractor has reason to believe the design, process or product specified constitutes an infringement of a patent, the Contractor shall be responsible for such royalties, license fees and loss unless the Contractor promptly gives such information to the Owner and the Professional.

4.6 Federal Clean Air Act

The Contractor agrees to fully protect, indemnify, hold harmless and defend the Owner against any and all liability, including assessed violation fines, for failure to comply with the Federal Clean Air Act [42 U.S.C. §7401 et seq., amended 1990], with regards to handling, venting, and/or disposing of any and all refrigerants used in the performance of the Work. A copy of employee(s) or subcontractor(s) Federal Certification numbers shall be provided to the Owner upon request.

Article 5 STANDARDS, SUBSTITUTIONS, AND SHOP DRAWINGS

5.1 STANDARDS

Whenever a material, product or process is specified by reference to a governmental, trade association or similar standard, it shall comply with the requirements of the latest publication thereof, and amendment thereto, in effect on the bid date. Such standards are as effectively part of the Contract Documents as if therein printed.

5.2 SUBSTITUTIONS

The various materials, products or equipment specified in the Specifications are mentioned for the purpose of establishing a standard of quality and cost. It is not the intent to limit to any one product, but rather to set up the same as the standard desired or acceptable and to establish a basis of equality. Where trade or proprietary names, catalog numbers and manufacturers of materials, products or equipment are used or specified, whether or not followed by the words "or equal as approved by the Professional," materials, products, or equipment to be equal in quality to that mentioned in the Specifications will be acceptable. It will be up to the Contractor, supplier and/or vendors to prove by the submission of proper data that their product is equal in quality to that specified.

These standards of quality were established and made only after careful study by the Professional and will, therefore, be strictly adhered to and all substandard materials, products or equipment will be rejected. Each Subcontractor, supplier and/or vendor shall in securing a substitution, submit a request in writing through the Contractor.

This request will then be forwarded to the Professional.

The Contractor shall obtain written approval of the Professional for all such substitutions of material, products, or equipment not less than five (5) working days before bids are due.

When submitting a request for a substitution, the requestor shall clearly indicate the item to be substituted, and shall include all calculations, catalog data, literature and/or drawings, so the substitution can be properly evaluated and processed in the shortest period of time.

Verbal communication regarding substitutions will not be construed as acceptance by the Professional and Owner, only written approvals on all substitutions will be valid.

The Professional will be the sole judge in evaluating and approving substitutions, and the Professional's decisions with the Owner's approval will be final.

No substitution for the above-named products or processes will be permitted after award of Contract, except as provided for below.

i. The Contractor may submit substitute products or processes for consideration, fully documented as stated above, and accompanied by Contractor's proposal the amount to be deducted from the Contract sum.

ii. A substitution submitted by the Contractor for reason that a product is not available will not be considered unless written proof is submitted that a firm order for the product was placed within 45 days after Notice to Proceed.

5.3 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Shop drawings, product data and samples are defined as follows:

5.3.1 Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures and other data prepared by the Contractor, or any Subcontractor, manufacturer, supplier, or distributor which illustrate some portion of the Work.

5.3.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

5.3.3 Samples are physical examples furnished by the Contractor to illustrate materials, equipment, or workmanship, and to assist in the establishment of standards by which the Work will be judged.

Shop Drawings, Product Data and Samples are not Contract Documents. The purpose of their submittal is to demonstrate how the Contractor proposes to comply with the information given and the design concept outlined in the Contract Documents.

5.3.4 Shop Drawing Submittal Schedule: Based on the priorities of the construction schedule, the Contractor shall submit a shop drawing submittal schedule on or before the Second Regular Job Conference.

The Professional shall review and check the shop drawing submittal schedule within fifteen (15) days of receipt from the Contractor.

The Contractor shall thereafter submit all shop drawings, product data and samples in accordance with the approved submittal schedule.

The Contractor shall review all shop drawings, product data and samples for compliance with the Contract Documents and shall certify that the Contractor has done so by stamp, or otherwise, affixed to each copy thereof. Submittal data presented without such certification will be returned without review or other comment, and any delay resulting therefrom will be the Contractor's responsibility. At the time of submission, the Contractor shall inform the Professional and Owner in writing of any deviation in the shop drawings, product data or samples from the requirements of the Contract Documents.

By approving and submitting shop drawings, product data and samples, the Contractor thereby represents that the Contractor has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so, and that the Contractor has checked and coordinated each shop drawing, product data and sample with the requirements of the Work and the Contract Documents and shall so certify as required above.

The Professional shall review, approve, and process, subject to the right of review by the Owner, shop drawings, product data, samples, and other submissions of the Contractor as to compliance with the Contract Documents and for conformity to and harmony with the design concept of the Project and for compliance with the requirements of the Contract Documents. The Professional shall not approve any substitution of or deviation from specified materials and/or equipment without first obtaining the Owner's consent.

The Professional shall return the approved shop drawings or detailed notation for resubmission if required, within twenty-one (21) calendar days after receipt from the Contractor. The Professional shall act on any resubmissions within fifteen (15) calendar days of receipt thereof. A detailed log shall be maintained by the Professional as to time of receipt of the shop drawings and time of return with adequate notes as to their disposition.

If the Contractor considers any correction indicated on the revised shop drawings to constitute a change to the Contract Drawings or Specification, written notice shall be given promptly to the Owner and the Professional.

The Contractor shall make any corrections required and shall resubmit the required number of corrected copies of the shop drawings, product data, or new samples of materials until approved. The Contractor shall direct specific attention in writing to any new revisions other than the corrections requested on previous submissions. No Work requiring a shop drawing, product data, or sample submission shall be commenced until the submission has been approved. All such Work shall be in accordance with contract documents which shall include approved shop drawings, product data, and samples.

The approval of the shop drawings, product data or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the Owner and the Professional in writing of such deviation at the time of submission and the Owner or the Professional has not objected to the specific deviation. The approval shall not relieve the Contractor from responsibility for errors or

omissions in the shop drawings, product data, or samples. The approval of a separate item shall not indicate approval of an assembly in which the item functions.

The Owner reserves the right to review all Submittal data. No Work required by these submittals shall be commenced until the submittal has been approved by the Professional and Owner.

The approval of shop drawings, product data and samples by the Professional shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory. Approval of shop drawings, product data and samples will not relieve the Contractor of the responsibility for any error which may exist therein, and the Contractor shall be responsible for the dimensions and design of adequate connections, details, and the satisfactory construction of all Work.

Work done contrary to this procedure shall be at the risk and expense of the Contractor. All shop drawings used for fabrication and erection shall be those approved by the Professional, without change. If change is found to be necessary on any approved shop drawings or sample, it shall be resubmitted to the Professional for review and approval.

The number of copies of shop drawings and other submittals will be established at the Initial Job Conference. The Contractor shall bear the cost of all required shop drawing reproductions and scanning, if applicable. The project may opt to use an electronic submittal process and the Contractor shall bear the cost of all submissions in the required electronic .pdf format.

If the project opts to use an electronic submittal process the Contractor is required to submit a complete set of approved electronic submittals in .pdf format organized by CSI division to the Owner at the time of Substantial Completion.

All Operation and Maintenance data is required to be submitted in electronic .pdf format to the Owner subsequent to approval by the Professional. The Contractor is required to organize information by system and CSI division. Exact requirements to be outlined by the Owner. One hard copy may also be requested by the Owner.

Article 6 KNOWLEDGE OF CONTRACT REQUIREMENTS

6.1 NOTICE

The Contractor, its Subcontractors and materialmen shall consult in detail the Project Manual, the General Conditions of the Contract, all Divisions and Sections of the Specifications, all Drawings, and all Addenda to the Project Manual for instructions and requirements pertaining to the Work, and at its and their cost shall provide all labor, materials, equipment, and services necessary to furnish, install and complete the Work in strict conformance with all provisions thereof.

6.2 EXAMINATION AND CONDITIONS AT THE SITE

The Contractor is responsible for having visited the site and having ascertained and informed itself, its Subcontractors, and materialmen, of all pertinent local conditions such as location, accessibility, and general character of the site or building, the character and extent of existing Work within and adjacent to the site, any other Work being performed thereon at the time of the submission of the Contractor's proposal, and subsurface conditions. Any failure to do so will not relieve the Contractor from responsibility for successfully performing the Work without additional expense to the Owner.

6.3 EXAMINATION OF CONTRACT DOCUMENTS

The Contractor will be held to have examined the Contract Documents, and Modifications thereto, as they may affect subdivisions of the Work and to have informed itself, its Subcontractors, Sub-subcontractors, and materialmen of all conditions thereof affecting the prosecution of the Work.

The Scope of the Work for the Contract is not necessarily limited to the description of each section of the Specifications and the illustrations shown on the drawings. Include all minor items not expressly indicated in the Contract Documents, or as might be found necessary as a result of field conditions, in order to complete the Work as it is intended, without any gaps between the various subdivisions of Work of the Contractor, or between the Work of all Subcontractors.

The Contractor shall at once report to the Professional errors, inconsistencies or omissions discovered. The Contractor shall not be liable to the Owner or Professional for damage resulting

from errors, inconsistencies, or omissions in the Contract Documents unless the Contractor recognized such error, inconsistency or omission and failed to report it to the Professional. If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency, or omission in the Contract Documents without such notice to the Professional, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

6.4 LABOR

The Contractor will be held to be thoroughly familiar with all conditions affecting labor in the location of the Project, including, but not limited to, unions, incentive pay, procurement, living and commuting conditions, and to have informed its Subcontractors and Sub-subcontractors thereof.

Article 7 CONTRACT ADMINISTRATION

7.1 7.1 GENERAL ADMINISTRATION

The Professional will provide general administration of the Contract beginning with the execution of the Agreement between the Contractor and the Owner until expiration of the Contractor's one year guarantee period against defective materials, equipment and/or workmanship.

The Professional shall advise and consult with the Owner and will have authority to act on behalf of the Owner to the extent provided in the Contract Documents. The extent of the Professional's duties and responsibilities and the limitations of the Professional's authority as outlined hereunder shall not be modified without written agreement between the Owner and the Professional.

7.2 CONTRACT ADMINISTRATION COMMUNICATIONS AND INTERPRETATION

7.2.1 Communications: The Owner assumes no responsibility for any understanding given or representation made orally by the Owner's agents prior to the execution of this Contract unless such understanding(s) or representation(s) are expressly stated in the Contract. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor. Any failure by the Contractor to become acquainted with available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the Work or mutually agreed changes thereto.

The Owner's instructions to the Contractor will generally be issued through the Professional except that the Owner reserves the right on appropriate occasions to issue instructions directly to the Contractor through the Owner's designated representative.

Communications by and with the Professional's consultants shall be through the Professional. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with the Owner's Separate Contractors shall be through the Owner.

All instructions affecting contract sum, contract time, or contract interpretation shall be confirmed expeditiously in writing with copies furnished to the Professional, the Owner's designated representatives, and the Contractor by the party issuing the instruction. No instruction affecting the Professional's design liability shall be issued without the Professional's prior written consent.

7.2.2 Interpretation: The Professional will be, in the first instance, the interpreter of the requirements of the Contract Documents. The Professional will, within a reasonable time, render such interpretation as the Professional may deem necessary for the proper execution or progress of the Work. All interpretations by the Professional shall be defined in writing and/or by drawing and shall be consistent with the intent of the Contract Documents. In its capacity as interpreter, the Professional will exercise its best efforts to insure faithful performance by the Contractor.

The Professional's decisions on matters relating to aesthetic effect will be final with the Owner's consent and if consistent with the intent expressed in the Contract Documents.

7.3 ACCESS TO AND INSPECTION OF THE WORK

The Professional, the Owner and their authorized representatives shall be provided full and safe access to the Work at all times by the Contractor for their observation and/or inspection of same.

The Professional, or an authorized and qualified representative, shall visit the project periodically as required by the Owner during periods of active construction, review the progress of the Work, and take such actions as in the Professional's judgment are necessary or appropriate to achieve the requirements of the Contract Drawings and Specifications in the Work of the Contractor, including advising the Owner as to particular matters to watch and guard against. The Professional will have its consultants visit the site periodically as required during their respective phases of the Work at such intervals as may reasonably be deemed necessary by the Owner and the Professional, to review their respective phases of the Work in order to achieve the requirements of the Contract Drawings and Specifications.

In addition to the above, the Professional shall be required to attend, at the determination of the Owner, any and all project site conferences dealing with interpretation of the Contract Documents.

The Owner shall be consulted by the Contractor on matters pertaining to the Work and shall transmit instructions of the Professional regarding the Work to the Contractor.

The Owner will, in addition to the Professional's inspection, inspect all Work under Contract. While the Owner will assist the Contractor in obtaining additional information in explanation of the Contract Documents and will serve as liaison between the Contractor and the Professional, the Owner is not empowered to authorize deviations from the Contract, except by a written modification as identified in Paragraph 1.1, nor to enter into the Contractor's area of responsibility for supervision and construction means, methods, techniques, sequences, procedures or coordination or for safety of persons and property. The fact that the Owner may have permitted faulty Work or Work not in accordance with the Contract Documents to be performed shall not relieve the Contractor from any responsibility to perform fully in accordance with the Contract.

The Work will be subject to inspection by the Owner and by representatives of the Professional as outlined above; however, such representatives are not authorized to make oral changes in any provision of the Drawings or Specifications except as provided in Article 9, Changes in the Work. Changes resulting from such inspections will be processed in the manner prescribed in Article 9. The absence or presence of the Owner shall not relieve the Contractor from any requirements of the Contract.

The Owner reserves the right to inspect, at their sources, all materials, supplies or services not manufactured or performed within the Contractor's on-site facility. Such inspection shall not constitute acceptance, nor shall it replace in any way the Contractor's responsibility for inspection or requirement to furnish acceptable materials.

The Owner will notify the Contractor of any non-compliance with the Contract Documents and the action required; and the Contractor shall take immediate corrective action. If the Contractor fails or refuses to take prompt action, the Owner may issue an order stopping all or part of the Work until the Contractor takes appropriate action. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

7.4 SEPARATE CONTRACTS

The Owner reserves the right to award other, separate contracts in connection with other portions of the Project under these or similar conditions of the Contract and/or to perform construction or operations related to the Project with the Owner's own forces.

When separate contracts are awarded for different portions of the Project, the term "this Contractor" shall mean the Contractor referred to in these Contract Documents, and the term "Separate Contractor" shall mean the Contractor who executes each separate Owner/Contractor Agreement.

If part of this Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, this Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Professional apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Upon receipt of such report, the Professional shall make a determination as to the unsuitability of such other construction. Failure of this Contractor to so report shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable and which may develop in the Owner's or Separate Contractor's construction after the execution of this Contractor's Work.

This Contractor shall promptly remedy damage wrongfully caused by this Contractor to be completed or partially completed construction or to property of the Owner or Separate Contractors. Should this Contractor cause damage to the Work or property of any Separate Contractor on the Project, this Contractor shall, upon due notice, endeavor to settle with such other Contractor by agreement. If such Separate Contractor sues the Owner on account of any damage alleged to have been so sustained, the Owner shall notify this Contractor who shall defend such proceedings and pay all costs in connection therewith, and if any judgment against the Owner arises therefrom, this Contractor shall pay or satisfy it.

This Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities and shall connect and coordinate this Contractor's construction and operations with theirs as required by the Contract Documents.

7.5 CLAIMS AND DISPUTES

7.5.1 Claims: Claims by either party must be made within twenty-one (21) days after occurrence of the event giving rise to such Claim or within twenty-one (21) days after the claimant first becoming aware or reasonably should have become aware of the condition giving rise to the Claim, whichever is later. Claims must be made by written notice. An additional Claim made after the initial Claim has been implemented by Change Order will not be considered unless submitted in a timely manner.

Pending final resolution of a Claim unless otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

7.5.2 Claims for Concealed or Unknown Conditions: If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or discoverable by the Contractor or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and no later than forty-eight (48) hours after first observance of the conditions. The Professional will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Professional determines that the conditions at the site are not materially different from those indicated in the Contract Documents or discoverable by the Contractor and that no change in the terms of the Contract is justified, the Professional shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within twenty-one (21) days after the Professional has given notice of the decision.

The failure by the Contractor to make the written notice and claims as provided in this subparagraph shall constitute a waiver by the Contractor of any claim arising out of or relating to such concealed or unknown condition.

7.5.3 Claims for Additional Cost: If the Contractor wishes to make Claim for an increase in the Contract Sum, the Contractor shall give written notice of such claim to the Professional and the Owner within twenty-one (21) days after the occurrence of the event or first appearance of the condition giving rise to such Claim and before proceeding to execute the Work. The failure by the Contractor to give such notice within the time permitted and prior to executing the Work shall constitute a waiver of claim for additional compensation. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 8.5.

In connection with any claim by the Contractor against the Owner for compensation in excess of the Contract Price, any liability of the Owner for the Contractor's costs shall be strictly limited to direct costs incurred by the Contractor and shall in no event include indirect costs or consequential damages of the Contractor. The Owner shall not be liable to the Contractor for claims of third parties, including Subcontractors, unless and until liability of the Contractor has been established therefore in a court of competent jurisdiction.

7.5.4 Claims for Additional Time: If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein shall be given to the Professional and the Owner at the time of any Change Order proposal submitted. If the Contractor believes additional time is involved for reasons including but not limited to (1) changes ordered to the Contract or because of (2) strikes, (3) lockouts, (4) fire, (5) unusual delay in transportation, (6) or any cause beyond the Contractor's control, which constitute a justifiable delay, Claim shall be filed in accordance with the procedure established herein.

If unusual inclement weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time and could not have been reasonably anticipated, and that weather conditions prevented the execution of major and/or critical items of the Work.

Unusual inclement weather as used herein means unusually severe weather which is beyond the normal weather recorded and expected for the locality and/or the season or seasons of the year. Normal weather shall be determined based on records for the closest stations of the United States Environmental Data Service and for a period of ten (10) years.

Any claim for extension of time on account of labor strike or lock-out shall be supported by a certificate of all facts concerning the strike, including, but not limited to, the dates, the crafts(s) concerned, the reason for the strike, efforts to resolve the dispute, and efforts to minimize the impact of the strike on progress.

Any claim for extension of time on account of delays in transportation, or for failure of suppliers, shall be supported by a certificate of all the facts involved, demonstrating that the delays were beyond the Contractor's control and including, but not limited to, the Contractor's efforts to overcome such delays.

If the Contractor fails to make such claim as required in this subparagraph within twenty-one (21) days of such occurrence giving rise to the claim, any claim for extension of time shall be waived.

7.5.5 Injury or Damage to Person or Property: If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, of any of the other party's employees or agents, or of others for whose acts such party is legally liable, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding twenty-one (21) days after first becoming aware of such injury or damage. The notice shall provide sufficient detail to enable the other party to investigate the matter. If a Claim for additional cost or time related to this Claim is to be asserted, it shall be filed as provided in Subparagraphs 7.5.3 or 7.5.4 respectively.

7.5.6 Decision of the Professional: Claims, including those alleging an error or omission by the Professional, shall be referred initially to the Professional for action as provided in Subparagraph 7.5.7. A decision by the Professional, as provided in Subparagraph 7.5.7, shall be required as a condition precedent to litigation of a Claim between the Contractor and Owner as to all such matters arising prior to the date final payment is due, regardless of (1) whether such matters relate to execution and progress of the Work or (2) the extent to which the Work has been completed. The decision by the Professional in response to a Claim shall not be a condition precedent to litigation in the event (1) the position of Professional is vacant, (2) the Professional has not received evidence or has failed to render a decision within agreed time limits, (3) the Professional has failed to take action required under Subparagraph 7.5.7 within thirty (30) days after the Claim is made, (4) forty-five (45) days have passed after the Claim has been referred to the Professional.

7.5.7 Resolution of Claims and Disputes: The Professional will review Claims and take one or more of the following preliminary actions within ten (10) days of receipt of a Claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Professional expects to take action, (3) reject the Claim in whole or in part, stating reasons for rejection, (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The Professional may also, but is not obligated to, notify the surety of the nature and amount of the Claim.

If a Claim has been resolved, the Professional will prepare or obtain appropriate documentation.

If a Claim has not been resolved, the party making the Claim shall, within ten (10) days after the Professional's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Professional, (2) modify the initial Claim or (3) notify the Professional that the initial Claim stands.

If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Professional, the Professional will notify the parties in writing that the Professional's decision will be made within seven (7) days. Upon expiration of such time period, the Professional will render to the parties the Professional's written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there appears to be a possibility of a Contractor's default, the Professional may, but is not obligated to, notify the surety, and request the surety's assistance in resolving the controversy.

7.6 CONTRACT TERMINATION

7.6.1 Termination by Contractor: If the Work is stopped for a period of ninety (90) days under an order of any court or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with the Contractor, then the Contractor may, upon ten (10) additional days' written notice to the Owner and the Professional, terminate the Contract and recover from the Owner payment for all Work executed and for any loss sustained upon any materials, equipment, tools, construction equipment and machinery, including reasonable profit associated with such Work or losses and reasonable expenses resulting from such termination.

If the cause of the Work stoppage is removed prior to the end of the ten (10) day notice period, the Contractor may not terminate the Contract.

7.6.2 Termination by Owner: If the Contractor refuses or fails, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials to perform the Work, or disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, or otherwise is in violation of a provision of the Contract Documents, or fails to so prosecute the Work as to insure its completion, within the time, or any extension thereof, specified in this Contract, then the Owner may, without prejudice to any right or remedy and after giving the Contractor and its surety ten (10) days' written notice, terminate the Work and services of the Contractor and take possession of the site and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor. In such case, the Contractor shall not be entitled to receive any further payment until the Work is finished.

If the Contractor shall generally not pay its debts as they become due or shall admit in writing its inability to pay its debts, or shall make a general assignment for the benefit of creditors; or if the Contractor shall commence any case, proceeding or other action seeking to have an order for relief entered in its behalf as debtor or to adjudicate it as bankrupt or insolvent, or seeking reorganization, arrangement, adjustment, liquidation, dissolution or
composition of it or its debts under any law relating to bankruptcy, insolvency, reorganization or relief of debtors or seeking appointment of a receiver, trustee, custodian or other similar official for it or for all or any substantial part of its property; or if the Contractor shall take any action to authorize or in contemplation of any of the actions set forth above in this paragraph, then this Agreement will automatically terminate upon written notification by Owner to Contractor and its surety.

Should the surety fail to respond within fifteen (15) days following the date of the notice of termination given to the surety and fail to pursue completion of the Work with diligence acceptable to the Owner, the Owner may arrange for completion of the Work and deduct the cost thereof from the unpaid Contract Sum remaining, including the cost of additional.

Professional services made necessary by such default or neglect, in which event no further payment shall then be made by the Owner until all costs of completing the Work shall have been paid.

If the unpaid balance of the Contract Sum exceeds the costs of finishing the Work, including compensation for the Professional's additional services made necessary thereby, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor or its surety shall pay the difference to the Owner. This obligation for payment shall survive the termination of the Contract.

7.6.3 Termination for Convenience of Owner: Prior to, or during the performance of the Work, the Owner reserves the right to terminate the Contract for unforeseen causes including but not limited to court orders, loss of funding, acts of the federal government to discontinue the Work, etc., that may occur. Upon such an occurrence, the following procedures will be adhered to:

7.6.3.1 The Owner will immediately notify the Professional and the Contractor in writing, specifying the effective termination date of the Contract.

7.6.3.2 After receipt of the notice of termination, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due at that point in the Contract:

(1) Stop all Work.

(2) Place no further subcontracts or orders for materials or services.

(3) Terminate all subcontracts.

(4) Cancel all material and equipment orders as applicable.

(5) Take action that is necessary to protect and preserve all property related to this Contract which is in the possession of the Contractor.

7.6.3.3 Within one hundred eighty (180) days of the date of the notice of termination, the Contractor shall submit a final termination settlement proposal to the Owner based upon costs up to the date of termination, reasonable profit on Work done only, and reasonable demobilization costs. If the Contractor fails to submit the proposal within the time allowed, the Owner may determine the amount due to the Contractor because of the termination and shall pay the determined amount to the Contractor.

7.6.3.4 If the Contractor and the Owner fail to agree on the settlement amount, the matter will be handled as a dispute through the procedures as outlined in Subparagraphs 7.5.6 and 7.5.7.

7.6.4 Written Notice: Written notice shall be considered to have been duly given if delivered in person to the individual or member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by United States mail to the last business address known.

Article 8 CONSTRUCTION

8.1 CONSTRUCTION SCHEDULE, FIELD MEASUREMENTS AND SUPERVISION

8.1.1 Construction Schedule: The Contractor, promptly after being awarded the Contract, shall prepare, and submit for approval by the Professional, a construction schedule for the Work. The schedule shall not exceed time limits as contained in the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

The construction schedule shall be coordinated with the Contractor's shop drawing submittal schedule.

8.1.2 Field Measurements: The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported to the Professional at once.

8.1.3 Supervision: The Contractor shall supervise and direct the Work. The Contractor shall be solely responsible for all construction means, methods, techniques, safety, sequences, and procedures, and for coordinating all portions of the Work under the Contract. The Contractor shall be responsible for inspection of portions of Work already performed under this Contract to determine that such portions are in proper condition to receive subsequent Work.

The Contractor shall employ a competent superintendent who shall attend the Project site during the progress of the Work. The superintendent shall be satisfactory to the Owner and shall not be changed except with the written approval of the Owner unless the superintendent leaves the employment of the Contractor. The superintendent shall represent the Contractor and shall have full authority to act on the Contractor's behalf. All communications given to the superintendent shall be as binding as if given to the Contractor. All oral communications affecting contract time, contract cost and contract interpretation will be confirmed in writing.

8.2 SUBCONTRACTS

As soon as practicable after the execution of the Contract, the Contractor shall submit to the Professional, for approval, a list of all Subcontractors, including those who are to furnish materials or equipment, that the Contractor and/or its major Subcontractors propose to employ in the construction of the Project. The Contractor shall not employ any Subcontractor to whom the Professional or Owner may have an objection.

A change in any approved Subcontractor or the addition of any new Subcontractor can only be made with the written approval of the Owner and Professional.

The Contractor agrees to bind every Subcontractor, and every Subcontractor agrees to be bound, by the terms of the Agreement, the General Conditions of the Contract, and the Drawings and Specifications insofar as they are applicable to the Subcontractor's respective portion of the Work. The Contractor shall furthermore fully inform each of its Subcontractors, prior to executing an

agreement with conformance with related documents and to submit Cost Estimates and Change Order proposals in complete and full analytical detail when so required or requested. The Contractor shall indemnify the Owner for any Subcontractor's claim which may result from the failure of the Contractor to incorporate the provisions of this Contract in the Contractor's agreements with any of its Subcontractors.

8.2.1 Contingent Assignment of Subcontracts: Each subcontract agreement for a portion of the Work is hereby assigned by the Contractor to the Owner provided that:

8.2.1.1 Assignment is effective only after termination of the Contract by the Owner for cause pursuant to Subparagraph 7.6.2 and only for those subcontract agreements which the Owner accepts by notifying the Subcontractor in writing.

8.2.1.2 Assignment is subject to the prior rights of the surety obligated under bond relating to the Contract.

8.3 PERMITS, FEES AND NOTICES

The Contractor shall secure and pay for, with the exception of the building permit, all other permits, fees, licenses, and inspections necessary for the proper execution and completion of the Work which are customarily secured after execution of the Agreement and which are legally required.

It is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations. However, if the Contractor observes that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Professional and Owner in writing, and necessary changes shall be accomplished by appropriate modification.

If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Professional and Owner, the Contractor shall assume full responsibility for such Work and shall bear the attributable costs.

8.4 ACTS AND OMISSIONS

The Contractor shall be responsible for acts and omissions of the Contractor's employees and Subcontractors, their agents and employees and other persons performing portions of the Work under a contract with the Contractor.

The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Professional in the Professional's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

8.5 PROTECTION OF PERSONS AND PROPERTY

8.5.1 OSHA: It shall be the duty and responsibility of the Contractor and all its Subcontractors and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor to be familiar and comply with all requirements of Public Law 91-596, the Occupational Safety and Health Act of 1970 (OSHA) and all amendments thereto, and to enforce and comply with all of the provisions of this Act.

8.5.2 Construction Safety Requirements: Contractor is obligated to adhere to the safety requirements as outlined in the following: Construction Safety Requirements, The Pennsylvania State University, Office of Physical Plant, Design and Construction Standards, Division 00, Sub-Section 00 01 00.

8.5.3 Emergencies: In an emergency affecting safety of persons or property, the Contractor shall act, at its discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be considered in accordance with Paragraph 7.5 and Article 9.

8.5.4 Precautions: The Contractor shall take appropriate precautions for safety of and shall provide necessary protection to prevent damage, injury, or loss to:

8.5.4.1 Employees of the Owner at the Work and other persons who may be affected thereby.

8.5.4.2 The Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors.

8.5.4.3 Other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, all necessary safeguards for safety and protection, including posting of danger signs, installing project fencing, and other warnings against hazards.

When the use of explosives is necessary for execution of the Work and such use is approved by the Owner, the Contractor shall conform to the procedures specified.

The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

8.5.5 Hazardous Material: The Contractor and all its Subcontractors and their agents and employees and other persons performing portions of the Work under a contract with the Contractor shall have no responsibility for the discovery, presence, handling, removal, or disposal of, or exposure of persons to hazardous materials in any form at the Project site, including but not limited to asbestos, asbestos products, polychlorinated biphenyl (PCB) or other toxic material.

If the Contractor encounters or suspects hazardous or toxic material, the Contractor shall advise the Owner immediately.

The Work in the affected area shall not be resumed by the Contractor until the hazardous material has been removed or rendered harmless by the Owner.

8.5.6 Property Damage Repair: The Contractor shall promptly remedy any damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Subparagraphs 8.5.4.2 and 8.5.4.3 caused in whole or in part by the Contractor, a Subcontractor, their agents and employees or any other persons performing portions of the Work under a contract with the Contractor.

8.6 MATERIALS AND WORKMANSHIP

The Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

All Work shall be executed in accordance with the Contract Documents, complete in all parts and in accordance with approved practices and customs, the finish specified and of the best workmanship. Unless otherwise specified, all materials and equipment incorporated in the Work under the Contract shall be new.

The Contractor shall provide, without extra charge, all incidental items required as a part of the Work, even though not particularly specified nor indicated and, if the Contractor has good reason for objecting to the use of a material, appliance, or method of construction as shown or specified, the Contractor shall register its objections to the Professional, in writing, sending a copy to the Owner; otherwise, the Contractor shall proceed with the Work, with the understanding that a satisfactory job is required.

8.6.1 Use of Site: The Contractor shall confine operations at the site to areas indicated in the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

Subject to prior approval of the Owner, the Contractor may use spaces within the building for shops and the storage of materials and equipment. Every space so used shall be repaired, patched, cleaned, and restored to new condition by the Contractor.

8.6.2 Cutting and Patching: The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a Separate Contractor except with consent of the Owner and of such Separate Contractor; such consent shall not be

unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a Separate Contractor the Contractor's consent to cutting or otherwise altering the Work.

The Contractor or a Subcontractor or Sub-subcontractor requiring the cutting of openings in, or relocation of, Work installed by others shall have such openings cut and patched and relocations made by the trade skilled in performing the particular Work; and such cutting, patching and relocation shall be at the expense of the Contractor, Subcontractor, or Sub-subcontractor requiring the opening or relocation.

8.7 TESTS AND INSPECTIONS

Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations, or orders of authorities having jurisdiction shall be made at an appropriate time. The Contractor shall schedule and coordinate such tests, inspections, and approvals with the independent testing laboratory. The Owner or Owner's agent will retain the testing services unless indicated otherwise by the contract documents. The Contractor shall give the Professional timely notice of when and where tests and inspections are to be made so the Professional may observe such procedures.

In addition, the Owner or the Professional may require special inspection, testing or approval of material or Work for compliance with the requirements of the Contract Documents. Upon direction of the Owner and Professional, the Contractor shall promptly arrange for such special testing, inspection, or approval procedure. Should the material or Work fail to comply with the requirements of the Contract Documents, the Contractor shall bear all costs of the testing, inspection, or approval as well as the cost of replacement of unsatisfactory material or Work as provided by Paragraph 8.8; otherwise, the Owner shall bear such costs and an appropriate Change Order shall be issued.

8.8 UNCOVERING, REJECTION AND CORRECTION OF WORK

8.8.1 Uncovering of Work: If any portion of the Work is covered contrary to the Professional's or the Owner's request or to the requirements of the Contract Documents, it must, if requested by the Professional or Owner, be uncovered for observation by the Professional or Owner. All costs of uncovering, recovering, and replacing of Work not installed in accordance with the Contract Documents shall be borne by the Contractor and with no change in Contract Time.

Any other portion of the Work requested to be uncovered by the Professional or the Owner and found not to be in accordance with the Contract Documents shall be replaced by the Contractor. The Contractor shall bear all the costs of uncovering and replacing of such Work. If the portion of Work uncovered is found to be in accordance with the Contract Documents, the costs of uncovering and recovering shall be paid by the Owner by appropriate Change Order.

8.8.2 Rejection and Correction of Work: Any Work rejected by the Professional or the Owner or found not to be in accordance with the Contract Documents shall be corrected promptly by the Contractor at its cost and with no change in Contract Time.

The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or Separate Contractors caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

If the Contractor fails to correct rejected or nonconforming Work, the Owner may correct it in accordance with Paragraph 8.9.

8.8.3 Acceptance of Nonconforming Work: If the Owner prefers to accept Work found not to be in accordance with the Contract Documents, the Owner may do so, in which case the Contract Sum will be reduced downward appropriately as determined by the Owner.

8.9 OWNER'S RIGHT TO STOP AND/OR CARRY OUT THE WORK

8.9.1 Owner's Right to Stop the Work: If the Contractor fails to correct rejected or nonconforming Work as required in Subparagraph 8.8.2 or fails to carry out Work in accordance with the Contract Documents the Owner may, in writing, order the Contractor to stop the Work, or any portion thereof until the proper corrective action has been implemented.

8.9.2 Owner's Right to Carry Out the Work: If the Contractor fails or neglects to carry out the Work in accordance with the Contract Documents, or ceases Work for a period of seven (7) consecutive days, the Owner may, without prejudice to other remedies the Owner may have, perform, or cause to be performed the Work.

In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of performing Work pursuant to this subsection. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

8.10 CONSTRUCTION FENCING

The General Contractor shall be required to provide a construction fence enclosing the area of the work within the central limits. Construction fencing is also required for trailers and stored material that may be located outside the area of work. Fencing material should be adequate to protect persons and property in accordance with the University's Contractor Safety Requirements as referenced in sub-Article 8.1.

8.11 EXISTING UNDERGROUND UTILITIES

8.11.1 The existence and locations of underground utilities indicated on the drawings are not guaranteed. The Contractor shall investigate and verify in the field before starting any work.

8.11.2 All excavation within three (3) feet of any existing underground utility line shall be accomplished by hand labor. Extreme caution shall be used in this area to prevent any damage to existing facilities.

8.11.3 The Contractor shall adequately protect from damage (including shoring, if necessary), all underground utilities uncovered or exposed. The Contractor shall be responsible for all damage to existing underground utilities caused by its work and shall repair by a method approved by the University.

8.11.4 Utilities serving existing buildings, installation, or facilities shall not be interrupted until the Contractor has made the necessary arrangements with and has received approval from the University.

8.11.5 In the event that interruption of any existing utility service is necessary, the responsible Contractor shall be required to make all arrangements for shutdown and start-up of such service with the University representative.

8.11.6 The University Park campus is traversed by a 12" high pressure gas transmission line. The Contractor must follow precautions and requirements as outlined on the plan set. The routing of the gas line is available on the OPP website (opp.psu.edu), at OPP Design and Construction Standards, Division 00, Sub-Section 3000.06. The Contractor must review the project location relative to the gas routing and coordinate all requirements with Columbia Gas.

8.12 CLEANUP

The Contractor shall keep the premises clean at all times of dirt, rubbish and debris resulting from the Work, and shall remove rubbish and debris in metal containers at the end of each working day. The Contractor shall remove rubbish and cartons resulting from the installation of fixtures and equipment. Prior to substantial completion of the Work, the Contractor shall do the final cleaning and polishing of the surfaces of the Contractor's installations as may be required by the various Specifications sections. The Contractor, in addition, shall employ a professional cleaning organization to remove all paint and stains from glass, and to wash all glass, throughout the Work, to clean and polish the finished surface of all fixtures, equipment and accessories and to vacuum clean all floors.

If the Contractor fails to clean up as outlined above, the Owner may do so, and the cost thereof shall be charged to the Contractor.

8.13 CONSTRUCTION WASTE MANAGEMENT

The contractor is required to recycle and/or salvage 75% of construction, demolition, and land clearing waste. A waste management plan is to be developed for the project which outlines how you will achieve the required recycling rate, including materials to be recycled or salvaged, materials handling requirements, and how you will communicate the plan to your crews and

subcontractors. The waste management plan is to be submitted and approved by the OPP Project Leader.

At the end of the project the contractor is required to submit a calculation documenting that the project achieved a 75% diversion rate. The documentation should include a tabulation of the total waste material, quantities diverted and the means by which diverted. A signature declaring that the requirements have been met must be included.

If the 75% diversion requirement is not met it will be documented on the contractor evaluation and this failure to meet the requirement is grounds for removal from the prequalification list.

If this project is attempting to achieve LEED certification, the LEED process to achieve the Construction Waste Management credit(s) supersedes this section.

Article 9 CHANGES IN THE WORK

9.1 CHANGES

Except as provided in this article, no order, oral statement, or direction of the Professional or the Owner shall be treated as a Change Order or entitle the Contractor to an adjustment to the Contract Sum and/or the Contract Time.

The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and the Contract Time being adjusted accordingly. All such changes in the Work shall be authorized by Change Order and shall be performed under the applicable conditions of the Contract Documents. If such changes cause an increase or decrease in the Contractor's cost of, and/or time required for, performance of the Contract, an equitable adjustment shall be made and confirmed in writing in a Change Order.

9.2 CHANGE ORDERS

A Change Order is a written order to the Contractor, signed by the Owner and issued after execution of the Contract, authorizing a change in the Work and/or an adjustment in the Contract Sum and/or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates the Contractor's agreement therewith, including the adjustment in the Contract Sum and/or the Contract Time. The Contractor shall submit all change orders on the Owner's latest Change Order Summary and Cost Breakdown forms. Failure to submit the correct forms, or the required information, will result in rejection.

It is recognized by the parties hereto and agreed by them that the Specifications and Drawings may or may not be complete or free from errors, omissions and imperfections or require changes or additions in order for the Work to be completed in accordance with the Contract Documents and to the satisfaction of Owner and that, accordingly, it is the express intention of the parties, notwithstanding any other provisions in this Contract, that any errors, omissions or imperfections in such Specifications and Drawings or any changes in or additions to same or to the Work ordered by Owner and any resulting delays in the Work or increases in Contractor's costs and expenses, shall not constitute or give rise to any claim, demand or cause of action of any nature whatsoever in favor of Contractor, whether for breach of contract, quantum merit, or otherwise; provided, however, that Owner shall be liable to Contractor for the sum stated to be due Contractor in any Change Order approved and signed by both parties, it being agreed hereby that such sum, together with any extension of time contained in said Change Order, shall constitute full compensation to Contractor for all costs, expenses and damages to Contractor, whether direct, consequential or otherwise in any ways incident to, arising out of, or resulting directly or indirectly from the Work performed by Contractor under such Change Order.

9.3 CHANGE ORDER CONTRACT SUM ADJUSTMENTS

Adjustments in the contract price for Work covered by a Change Order shall be computed on the basis of one or more of the following procedures. The Contractor shall have a maximum time of fourteen (14) calendar days to submit change order pricing, unless otherwise directed by the Owner.

9.3.1 Unit Prices: Unit prices as stated in the Contract Documents or subsequently mutually agreed upon by the Owner and the Contractor for the increase or reduction in the Work or portion thereof.

Unit prices shall be inclusive of all costs and shall be applied to units of measure as defined in the Contract Documents for each category of Work.

9.3.2 Lump Sum: A lump sum agreed upon by the Owner and Contractor based on an estimated cost of the increase or reduction in the Work properly itemized and supported by sufficient substantiating data to permit evaluation.

9.3.3 Actual Cost: The actual cost of the Work as determined from job records after the completion of the extra Work. For Work done under this paragraph, the Contractor shall maintain and submit to the Owner for review and approval as directed by the Owner, accurate accounts of all costs and supporting data. There shall be a lump sum cost-not-to-exceed agreed upon by the Owner and Contractor before this provision is used.

9.3.4 Net Cost of Increase or Reduction in the Work: The net cost of the estimated or actual cost of the Work shall be the actual or prorated cost of:

9.3.4.1 Labor at the prevailing rate of wages and fringe benefits.

9.3.4.2 Materials entering permanently into the Work, including delivery to the site.

9.3.4.3 The ownership or rental cost of construction equipment at actual cost, prorated for the time necessary for the Work.

9.3.4.4 Power and consumable supplies for the operation of power equipment at actual cost, prorated for the time necessary for the Work.

9.3.4.5 Insurance and bond costs only when supported by paid invoice.

9.3.4.6 When a change in the Work includes a category or categories of Work both added to and deleted from the Contract, the total quantities of added Work and of deleted Work shall be determined separately for each category and the appropriate Unit Price or net cost of the Work shall be the difference between the two total quantities.

9.3.5 Gross Cost of Increase or Reduction in the Work: The gross cost to the Owner for the estimated or the actual cost of the Work performed by the Contractor or Subcontractor shall include the net cost of the Work to the Contractor or Subcontractor plus an allowance for overhead and profit. The Contractor or Subcontractor **actually performing the Work** will be allowed a maximum markup for overhead and profit of 10% on labor, material and equipment (not including sales tax). Markup on sales tax is not permitted.

In addition to the markups allowed for labor, material, and equipment for the Contractor or Subcontractor **actually performing the Work**, the Owner will pay a maximum aggregate markup of 10% for Subcontractor management on the **actual** cost of the Work performed regardless of tier. **No other costs or markups will be permitted by any other tiered Contractor or Subcontractor**.

9.3.6 If no mutual agreement can be reached between the Owner and the Contractor as to the method to complete the Work covered by a Change Order, the change in the Contract Price, if any, shall then be determined on the basis of the reasonable expenditures or savings of those performing, deleting, or revising the Work attributable to the change. In such case, the Contractor shall present, in such form and with such contents and details as the Owner requires, an itemized accounting of such expenditures or savings, plus appropriate supporting data for inclusion in a Change Order. Reasonable expenditures or savings shall be limited to the following: reasonable costs of materials, supplies, or equipment, including delivery costs; reasonable costs of labor and fringe benefits required by agreement or custom; reasonable rental or Owner costs of machinery and equipment exclusive of hand tools whether rented from the Contractor or others; actual costs of premiums for all bonds and insurance only when supported by paid invoice specific to change, permit fees, and sales, use, or other taxes related to the Work. In no event shall any expenditure or savings associated with the Contractor's home office or other non-job site overhead expense be included in any change in the Contract Price. Allowance for overhead and profit shall be determined in accordance with Subparagraph 9.3.5.

9.3.7 If a Change Order submission is rejected and the work is considered part of the Contract Price by the Professional and Owner, work shall be considered a claim to the Contract. Pending final resolution of a Claim, unless otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract. If the Contractor refuses to complete the work the Owner may proceed in accordance with Subparagraph 8.9.2.

9.3.8 Mark-up on bond premium increases and/or insurance premium increases due to Change Orders is not permitted.

9.4 CHANGE ORDER CONTRACT TIME ADJUSTMENTS

Adjustments in the time required for performance of the Contract for Work covered by a Change Order shall be as agreed upon by the Owner and the Contractor as part of the Change Order. If the parties are unable to agree on the time extension or reduction, the Professional shall decide of the time extension or reduction to be allowed for a change.

9.5 MINOR CHANGES IN THE WORK

The Professional, with the Owner's approval, will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time. Such changes will be affected by written order which the Contractor shall carry out promptly.

9.6 NOTICE TO SURETY: CONSENT

The Contractor shall notify and obtain the consent and approval of the Contractor's surety with reference to all Change Orders if such notice, consent, or approval are required by the Contractor's surety or by law. The Contractor's execution of the Change Order shall constitute the Contractor's warranty to the Owner that the surety has been notified of and consents to such Change Order, and the surety shall be conclusively deemed to have been notified of such Change Order and to have expressly consented thereto.

9.7 EFFECT OF EXECUTED CHANGE ORDER

The execution of a Change Order by the Contractor shall constitute conclusive evidence of the Contractor's agreement to the ordered changes in the Work, this Contract as thus amended, the Contract Price and the Contract Time. The Contractor, by executing the Change Order, waives and forever releases any claim against the Owner for additional time or compensation for matters relating to or arising out of or resulting from the Work included within or affected by the executed Change Order.

Article 10 CONTRACT COMPLETION TIME

10.1 NOTICE TO PROCEED

The Contractor agrees to begin the Work contemplated by this Contract within Ten (10) days after receipt of an executed contract or as directed by Owner and the Contractor is required to complete the Work in the time stated therein and in the Agreement.

10.2 PROGRESS AND COMPLETION

Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

10.3 DELAYS AND EXTENSIONS OF TIME

If the Contractor is delayed at any time in progress of the Work by an act or neglect of the Owner or Professional, or of an employee of either, or of a separate Contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner, or by other causes which the Professional determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Professional may determine with the Owner's approval.

Claims relating to time shall be made in accordance with applicable provisions of Subparagraph 7.5.

This Paragraph 10.3 does not preclude recovery of damages for delay by the Owner under other provisions of the Contract Documents.

Apart from extension of time, no payment or claim for damages shall be made to the Contractor as compensation for damages for any ordinary delays or hindrances from any cause whatsoever in the progress of the Work, notwithstanding whether such delay be avoidable or unavoidable.

10.4 COMPLETION AND LIQUIDATION DAMAGES

The Contractor shall substantially complete all of the Work included in the Contract Documents ready for the Owner's use and occupancy, in the Contract Time noted in the Contractor's Form of Proposal and the Agreement subject to extensions of Contract Time as provided in Paragraph 10.3 above. Pursuant to the provisions of Paragraph 10.4, for each calendar day's delay in said completion, the Contractor shall pay to the Owner as liquidated damages, and not as a penalty, the sum in the amount noted in the Project Manual and the Agreement. The Contractor and its surety shall be liable for the amount thereof.

Any delay attributable to lack of coordination or cooperation by or between the Contractor and its Subcontractor(s) will not be recognized by the Owner as the basis for any claim for increase in the Contract Sum or Contract Time.

10.5 SUBSTANTIAL COMPLETION

When the Contractor considers that the Work, or a portion thereof which the Owner wishes or agrees to accept separately, is substantially complete in accordance with Paragraph 1.15, the Contractor shall prepare for submission to the Professional and the Owner a list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. When the Professional and the Owner, on the basis of an inspection, determine that the Work is substantially complete, the Professional or Owner will then prepare a Substantial Completion Inspection Report which shall establish the Date of Substantial Completion; shall state the responsibilities of the Owner and the Contractor for maintenance, heat, utilities, operation of permanent equipment, warranty and insurance; and shall fix the time within which the Contractor shall complete the items listed therein. The Substantial Completion Inspection Report shall be submitted to the Contractor as their notification of the responsibilities assigned to each of them.

The Contractor shall be charged with any cost for reinspection resulting from substantial differences between the Contractor's list of items to be completed or corrected and the list of items resulting from the Professional and Owner's inspection.

10.6 PARTIAL OCCUPANCY

The Owner may take occupancy or make use of any substantially completed portion of the Work at any stage.

The procedures for the preparation of a list of items to be completed or corrected, Partial Occupancy Inspection and Inspection Reports are to be followed as outlined in Paragraph 10.5 above.

The Contractor agrees that the Owner may place and install as much material, equipment, and furnishings as is possible during construction without interfering with orderly progress of the Work and prior to use and occupancy of the various parts of the Work, and further agrees that such placing and installation shall not evidence completion of the Work or signify the Owner's acceptance of the Work or any part thereof.

Partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

Article 11 PAYMENTS AND COMPLETION

Contractor Payment Application (CPA) process referenced in this Article shall be as per the Owners Project Management Information System (PMIS) as described Article 14.3.

11.1 SCHEDULE OF VALUES

Upon execution of the Agreement between the Owner and the Contractor, the Contractor shall submit a breakdown of the Contract price itemizing material and labor for the various classifications of the Work. The breakdown will be used as the basis for the progress payments of the Contract.

The schedule shall be tabulated into subcontracts and trades, each of which the Quantity, Labor, Material, Other Cost, and resulting final Cost per Unit shall be indicated. Labor, Material, Other Cost, Cost per Unit, and Quantity generally include but are not limited to the following:

11.1.1 Quantity: Total number of items for each portion or Unit of Work as determined from the Contract Documents.

11.1.2 Labor: On-site labor required for the handling and installation of material from point of delivery at site.

11.1.3 Material: Cost of material as delivered to site for installation and erection.

11.1.4 Other Costs: Rental equipment, depreciation, site office, administration, overhead and profit, testing, survey and layout, samples, and other costs not included in Labor and Material.

11.1.5 Cost per Unit: Total of Labor, Material, and Other Cost for each portion or Unit of Work derived from the total Quantity of same.

The Contractor's CPA shall reflect the same items as outlined above. Unit costs shall be realistic for their part of the Work.

11.2 APPLICATIONS FOR PAYMENT

Except as otherwise agreed in writing by the parties, and except for any amounts withheld or disallowed due to deficiencies or errors in documentation as defined in Paragraph 11.5 below, payment of progress and final payment applications shall be due from the Owner forty-five (45) days after submission of a complete and accurate CPA.

Within ten (10) calendar days of the effective date hereof, the Contractor shall submit to the Owner through the PMIS Schedule of Values (SOV) process allocating the Contract Price to the various portions of the Work. The Contractor's SOV shall be prepared in such form, with such detail, and supported by such data as the Professional or the Owner may require substantiating its accuracy. The Contractor shall not imbalance its SOV nor artificially inflate any element thereof. The violation of this provision by the Contractor shall constitute a material breach of this Contract. The SOV shall be used only as a basis for the CPA and shall only constitute such basis after it has been approved and documented by the Professional and the Owner.

Ten (10) days before the date established for each progress payment submittal to the Owner, the Contractor shall submit an itemized CPA for construction activities completed in accordance with the approved SOV and which shall reflect the appropriate retainage as outlined.

Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner may require, including weekly payroll certification (Commonwealth of Pennsylvania Department of Labor and Industry form LLC-25) if applicable.

Such applications may include requests for payment on account of changes in the Work which have been properly authorized by Change Order and fully executed.

Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier because of a dispute or other reason.

The Contractor warrants that title to all Work covered by a CPA will pass to the Owner at the time of payment. The Contractor further warrants that upon submittal of a CPA all Work for which payments have been previously issued and received from the Owner shall be free and clear of liens, Claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a Claim by reason of having provided labor, materials and equipment relating to the Work.

This provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and Work upon which payments have been made or the restoration of any damaged Work, or as a waiver of the right of the Owner to require the fulfillment of all the terms of the Contract.

Payments to the Contractor shall not be construed to release the Contractor or its surety from any obligations under this Contract.

A payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

11.3 PAYMENTS FOR STORED MATERIAL

Payments on account of materials or equipment not incorporated in the Work but delivered and suitably stored at the site, or at some other location agreed upon in writing, will be made by the Owner subject to the following conditions:

11.3.1 Such materials or equipment shall have been fabricated or assembled specifically for the Project and delivered to storage no earlier than needed for the orderly progress of the Work as demonstrated by the Progress Schedule.

11.3.2 Title to such materials or equipment shall pass to the Owner pursuant to the Contractor's bill of sale which shall contain a guarantee of replacement thereof in the event of damage thereto or disappearance thereof due to any cause. Payment by the University for stored material will be made only upon receipt of the Contractor's paid-in-full invoice from the manufacturer or supplier.

11.3.3 In the case of off-site storage, the Contractor shall also provide consent of Surety to such payment and insurance of such materials or equipment against the perils set forth in Paragraph 3.3, both while in storage and during transportation to the site.

11.3.4 Raw materials or other materials or equipment readily duplicated or usable on other projects will be paid for only after the materials are incorporated into the Project.

11.3.5 Any other documentation as requested by the Owner.

11.4 CONTRACTOR PAYMENT APPLICATION (CPA)

Based on observations of the Work by the Professional and/or the Owner, recommendations will be made within seven (7) days (except as otherwise provided in Paragraph 11.5.8 below) after receipt from the Contractor, approval of CPA payment o or notify the Contractor and Owner in writing of the Professional's reason(s) for withholding its recommendation in whole or in part as provided in Paragraph 11.5 below.

Contractor will submit the CPA to the Owner. The Owner may forward to the Professional. The Professional shall review and comment on the CPA so as to indicate the disapproval of those items for which payment is to be withheld or disallowed and to indicate the corrected values, and shall forward to the Owner for further processing, except that, should the Professional disapprove payment of the entire progress payment, the disapproved CPA will be returned to the Contractor, with notification of said return provided to the Owner by the Professional.

Approval of the CPA shall constitute a representation by the Professional to the Owner that the Work has progressed to the point indicated on the Application, and that to the best of the

Professional's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents.

The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the Professional. The issuance of a CPA will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a CPA will not be a representation that the Professional has (1) made exhaustive or continuous on-site inspections to check the quality and quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum. Upon Substantial Completion of the Work and upon written request of the Contractor, certification by the Professional and approval of the Owner, retainage for the uncompleted portion of the Work may be reduced to a percentage mutually agreed upon by all parties.

The CPA MUST include the following: **(Failure to submit any of the following will deem the CPA incomplete)**

First/Progress Payment

- Steel Certifications – If no steel was used, fill out the form and choose option 1A.
- Weekly Certified Payroll.
- DBE Section completion, as applicable, in addition, if a DGS project a Small Diverse Business Utilization Report (SDBUR) shall also be attached.

11.5 WITHHOLDING OF PAYMENT

The Professional or the Owner may decline to make payment, may withhold funds, and if necessary, demand the return of some or all of the amounts previously paid to the Contractor or nullify that part of any CPA to such extent as may be necessary to protect the Owner from loss because of any of the following:

11.5.1 Retainage of six (6) percent of the amount otherwise due shall be withheld from each progress payment before Substantial Completion. Owner may, in its sole discretion, reduce the amount to be retained at any time.

11.5.2 Defective Work not yet remedied by the Contractor or defective work, in the opinion of the Owner, not likely to be remedied by the Contractor.

11.5.3 Third party claims filed or reasonable evidence indicating probable filing of such claims.

11.5.4 Failure of the Contractor to make payments promptly and properly to Subcontractors or others**.**

11.5.5 Any evidence that the Work cannot be completed for the unpaid balance of the Contract Sum.

11.5.6 Damage to the Owner, another Contractor, or any third party.

11.5.7 Any evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay.

11.5.8 Failure to carry out the Work in accordance with the Contract Documents.

11.5.9 Errors in Documentation: If a CPA is filled out incorrectly or incompletely, or if there is any other defect or impropriety , the Professional or Owner shall give notice through the process to the Contractor within ten (10) working days after receipt of the CPA, and the Owner shall make payment for the correct amount to the Contractor provided the CPA is approved by the Professional in accordance with this Agreement.

11.5.10 Lack of required submissions as outlined in the General Conditions of the Contract. If the Contractor and Professional cannot agree on a revised amount, the CPA will be processed in accordance with Article 11.4.

When the above reason(s) for withholding recommendation or nullifying any part of a CPA are removed, recommendation and payment will be made for amounts previously withheld.

11.6 PAYMENTS TO SUBCONTRACTORS

Upon receipt of payment from the Owner, the Contractor shall promptly pay each Subcontractor, out of the amount paid to the Contractor the amount to which said Subcontractor is entitled, reflecting percentages retained from payments to the Contractor on account of such Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in similar manner.

The Professional or Owner will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Professional and Owner on account of portions of the Work done by such Subcontractor.

Neither the Owner nor Professional shall have an obligation to pay or to see to the payment of money to a Subcontractor.

Payment to material suppliers by the Contractor shall be treated in a manner similar that provided above.

11.7 FAILURE OF PAYMENT

If the Professional does not recommend approval of payment, through no fault of the Contractor, within fourteen (14) days after receipt of the CPA , or if the Owner does not pay the Contractor within a reasonable time the amount certified by the Professional, then the Contractor may, upon seven (7) additional days' written notice to the Owner and Professional, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately, and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay, and start-up, which shall be accomplished as provided in Article 9.

11.8 FINAL COMPLETION AND FINAL PAYMENT

11.8.1 Notification: When the Work is completed, the Contractor shall provide notification of the Contractor’s readiness for inspection through the PMIS Punchlist process The Owner and Professional shall review, confirm, and verify the Punchlist within the process instance. When the Contract is fully performed, the Owner will make final payment to the Contractor.

11.8.2 Final Payment Documentation: The final payment for the remaining retained percentage shall not become due until the Contractor submits to the Owner the following: **(Failure to submit any of the following will deem the CPA incomplete)**

- Steel Certifications – If no steel was used, fill out the form and choose option 1A.
- Contractor's Affidavit for Final Payment and Waiver of Mechanics Liens - an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might in any way be responsible, have been paid or will be paid or otherwise satisfied within thirty (30) days after receipt of final payment from the Owner.
- Consent of Surety to Final Payment
- Certified Payroll
- DBE Section completion, as applicable, in addition if a DGS project a Small Diverse Business Utilization Report (SDBUR) shall also be attached.
- All maintenance manuals, as-built drawings and warranty certificates that may be required. If any third party fails or refuses to provide a release of claim or waiver of lien as required by Owner, the Contractor shall furnish a bond satisfactory to the Owner to indemnify the Owner from liability.

11.8.3 Final Payment: Acceptance of final payment by the Contractor shall constitute a waiver of all claims by the Contractor except those specifically enumerated in writing previously and identified in writing as unsettled at the time of final payment.
The making of final payment shall constitute a waiver of Claims by the Owner except those arising from any of the following:

11.8.3.1 Liens, Claims, security interests or encumbrances arising out of the Contract and unsettled.

11.8.3.2 Failure of the Work to comply with the requirements of the Contract Documents.

11.8.3.3 Terms of special warranties required by the Contract Documents.

Article 12 CONTRACT WARRANTY PERIOD

12.1 WARRANTY

Except as otherwise specified, the Contractor warrants and guarantees all Work against defects in materials, equipment and/or workmanship for a period of one (1) year from the date of Substantial Completion of the entire Project or Partial Occupancy of any portion thereof and for that period of time noted in any special or extended warranty.

This period of one (1) year shall be extended with respect to portions of the Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work.

If building commissioning work is not complete at the time of substantial completion, the warranty period for all related building systems may be extended by the Owner. Documentation by the Owner shall be submitted at the time of substantial completion indicating the building systems not yet properly commissioned. Once the building systems have been completed to the satisfaction of the Owner, a letter will be issued by the Owner indicating the listing of building systems and equipment with the revised warranty period. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation or normal wear and tear under normal usage.

This warranty and guarantee are not the exclusive remedy of the Owner but is in addition to the general obligation of the Contractor to faithfully perform the Contract, and it in no way limits the responsibility of the Contractor for faulty materials or workmanship.

12.2 CORRECTION OF DEFECTS

Upon receipt of written or verbal notice from the Owner or Professional of the discovery of any defects in materials, equipment and/or workmanship, the Contractor shall remedy the defects and replace any property damaged therefrom occurring within the warranty and guarantee period. Any defects discovered in materials, equipment and/or workmanship which are included in any manufacturer's written warranty certificate shall be remedied in accordance with the manufacturer's recommendations and procedures.

If any of the Work is found to be not in accordance with the requirements of the Contract Documents, including substitutions not properly approved and authorized, such Work will be considered defective and shall be corrected promptly by the Contractor after receipt of notice from the Owner or Professional.

If the Contractor, after notice, fails to proceed promptly and remedy such defects within thirty (30) days or within another period of time which has been agreed to in writing, in compliance with the terms of the warranty and guarantee, the Owner may have the defects corrected and the Contractor and its surety shall be liable for all expenses incurred.

12.3 ONE-YEAR INSPECTION

Prior to the expiration of the one (1) year guarantee period against defective materials, equipment and/or workmanship, the Professional and Owner shall conduct an inspection to determine any other defects in material, equipment and/or workmanship not previously noticed and corrected as outlined in Paragraph 12.2 above.

Should any additional defects be discovered, the Contractor, upon receipt of written notice from the Professional or Owner, shall promptly remedy the defects and replace any property damaged therefrom.

If the Contractor, after notice, fails to proceed promptly and remedy such defects within thirty (30) days or within another period of time which has been agreed to in writing, in compliance with the terms of the warranty and guarantee, the Owner may have the defects corrected and the Contractor and its surety shall be liable for all expenses incurred.

Article 13 EQUAL EMPLOYMENT OPPORTUNITY

13.1 NON-DISCRIMINATION CLAUSE

During the term of this Contract, Contractor agrees as follows:

13.1.1 Contractor shall not discriminate against any employee, applicant for employment, any independent Contractor or any other person because of race, color, religious creed, ancestry, national origin, service in the uniformed services (as defined in state and federal law), veteran status, age, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas, or any other basis prohibited by law. Contractor shall take affirmative action to ensure that applicants are employed, and that employees or agents are treated during employment, without regard to their race, color, religious creed, ancestry, national origin, service in the uniformed services (as defined in state and federal law), veteran status, age, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas, or any other basis prohibited by law. Such affirmative action shall include, but is not limited to, the following: Employment upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training.

Contractor shall post in conspicuous places, available to employees, agents, applicants for employment and other persons, notices to be provided by the contracting agency setting forth the provisions of this non-discrimination clause.

13.1.2 Contractor shall in solicitations or advertisements placed by it or on its behalf state all qualified applicants will receive consideration for employment without regard to race, color, religious creed, ancestry, national origin, age, or sex.

13.1.3 Contractor shall send each labor union or workers' representative with which it has a collective bargaining agreement or other contract or understanding, a notice advising said labor union or workers' representative of its commitment to this non-discrimination clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment. Similar notices shall be sent to every other source of recruitment utilized by Contractor.

13.1.4 It shall be no defense to a finding of a non-compliance with Executive Order 1972-1 or any regulations issued by the Pennsylvania Human Relations Commission or this non-discrimination clause that recipient had delegated some of its employment practices to any union, training program or other source of recruitment which prevents it from meeting its obligations.

13.1.5 Where the practices of a union or any training program or other source of recruitment will result in the exclusion of minority group persons, so that Contractor will be unable to meet its obligations under Executive Order 1972-1 or any regulations issued by the Pennsylvania Human Relations Commission or this non-discrimination clause, the Contractor shall then employ and fill vacancies through other employment procedures without regard to race, color, religious creed, ancestry, national origin, sex, or age, taking affirmative action to obtain qualified minority group persons.

13.1.6 Contractor shall comply with all rules, regulations and orders issued by the Governor, the Attorney General, and the Human Relations Commission relating to laws, prohibiting discrimination in hiring or employment opportunities. In the event of Contractor's non-compliance with the non-discrimination clause of this Contract or with any such rules, regulations or orders, this Contract may be cancelled, terminated or suspended in whole or in part, and recipient may be declared ineligible for further Commonwealth contracts, and such other sanctions may be imposed and remedies invoked as provided by rule, regulation or order of the Governor, Attorney General, or the Human Relations Commission, or as otherwise provided by law.

13.1.7 Contractor shall furnish all information and reports required by the Governor, Attorney General, and the Human Relations Commission and will permit access to its books, records and accounts by the contracting agency and the Human Relations Commission, for purposes of investigation to ascertain compliance with provisions of Executive Order 1972-

1 or any regulations issued by the Pennsylvania Human Relations Commission or this non-discrimination clause.

13.1.8 Contractor shall actively recruit minority Subcontractors or Subcontractors with substantial minority representation among their employees.

13.1.9 Contractor shall include the provisions of Paragraphs 13.1.1 through 13.1.10 in every Subcontract or Purchase Order, so that such provisions will be binding upon each Subcontractor or vendor or other person.

13.1.10 The terms used in this non-discrimination clause shall have the same meaning as in the Contract Compliance Regulations issued by the Pennsylvania Human Relations Commission, 16 Pa. Code Ch. 49.

Article 14 MISCELLANEOUS PROVISIONS

14.1 RIGHTS AND REMEDIES

Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

No actions or failure to act by the Owner, Professional or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

14.2 SMOKING AND TOBACCO POLICY

Smoking and the use of tobacco are prohibited in and on all University owned or leased properties, facilities, and vehicles, per University Policy AD 32.

14.3 ELECTRONIC PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

The Contractor shall utilize the PMIS during all phases of the project, unless directed otherwise by the Owner. All project specific correspondence, workflow processes, and documentation will be stored and routed within the PMIS. The Contractor and the Owner shall agree on file name convention of submissions in advance.

The Contractor, or those direct-employee(s) responsible, on each project will be expected to participate in the necessary training to use the PMIS effectively. Periodic training sessions on the PMIS will be provided by the Owner. Registration will be through Penn State's Learning Resource Network (LRN). It is the responsibility of the Contractor to coordinate with the Owner regarding the training schedule and to register via the LRN. All costs for personnel time, travel, meals, and lodging to attend the training shall be borne by the Contractor and, as such, will not be reimbursed by the Owner.

The Contractor shall obtain, at their own cost, the necessary equipment and web connections to access and utilize the PMIS. The Contractor will not incur any registration fees or licensing costs to utilize the PMIS.

The Owner will not entertain or acknowledge any amendment requests by the Contractor for claimed inefficiencies or other costs related to the implementation and subsequent use of the PMIS.

14.4 USE OF UNMANNED AIRCRAFT (UA)

If the Work involves the use of UA (Drones), and if UA use is approved by the Penn State Project Manager assigned to the job in question, the Professional and those Subconsultants involved in UA use must follow all applicable federal regulations and the requirements of Penn State policy SY45 (https://policy.psu.edu/policies/sy45), which defines the requirements for use of UA on property owned or controlled by Penn State. In addition, a request to operate UA must be submitted to Penn State's UA Operations Manager, as specified at: https://www.research.psu.edu/UasOperations. UA flight operations may not proceed until approval is granted by the UA Operations Manager.

Article 15 PERFORMANCE AND PAYMENT BONDS

At the time of signing the Contract and before it becomes effective, the Contractor and its surety, acceptable to the Owner, shall execute two bonds each in the amount of 100% of the contract price of the Work awarded to the Contractor. The Bonds shall be written by a Surety authorized to do business in the

Commonwealth of Pennsylvania and shall be delivered to the Owner prior to award of Contract and within three (3) days of the Owner's request thereof. The Attorney-in-Fact who signs the Bonds must be a resident of the Commonwealth of Pennsylvania and shall file with each Bond a certified and effectively dated copy of the Attorney-in-Fact's Power of Attorney.

One bond shall be a performance bond covering the faithful performance by the Contractor of all covenants and agreements on the part of the Contractor contained in this Contract.

The other bond shall be a labor and material payment bond protecting all parties that have performed labor or supplied material on this Contract from suffering any loss due to the failure of the Contractor to pay any or all obligations incurred under this Contract.

The Contractor shall pay all premiums for all bonds.

Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor or Owner shall promptly furnish a copy of the bonds or shall permit a copy to be made.

Article 16 INDEMNITY

To the fullest extent permitted by law, the Contractor shall appear for and defend, indemnify, and hold harmless the Owner, Professional, Professional's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, of whatsoever nature caused in whole or in part by the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Article 16.

In claims against any person or entity indemnified under this Article 16 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Article 16 shall not be limited by a limitation on amount or type of damages, compensation or benefits payment by or for the Contractor or a Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

The obligations of the Contractor under this Article 16 shall not extend to the liability of the Professional, the Professional's consultants, and agents and employees of any of them arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications, or (2) the giving of or the failure to give directions or instructions by the Professional, the Professional's consultants, and agents and employees of any of them, provided such giving or failure to give is the primary cause of the injury or damage.

The status of the Contractor in the Work to be performed by it under this Contract is that of an Independent Contractor and as such the Contractor shall properly safeguard against any and all personal injury including death, or damage to the public, to public and private property, materials, and things; and as such, the Contractor alone shall be responsible for any and all damage, loss, or injury to persons or property that may arise or be incurred in or during the conduct or progress of said Work without regard to whether or not the Contractor, its Subcontractors, Agents, or Employees have been negligent; and the Contractor shall keep the Owner and Professional indemnified from and discharged of and from any and all responsibility and liability for risks and casualties of every description, as provided in the Agreement between the Owner and the Contractor.

GENERAL CONDITIONS OF THE CONTRACT

SECTION D1

NOTIFICATION OF CONTRACT REQUIREMENTS PERTAINING TO THE PREVAILING WAGE ACT

1. The Contractor shall pay no less than the wage rates as determined in the decision of the Secretary of Labor and Industry and shall comply with the conditions of the Pennsylvania Prevailing Wage Act approved August 15, 1961 (Act No. 442), as amended August 9, 1963 (Act No. 342), and the Regulations issued pursuant thereto, to assure the full and proper payment of said rates.

2. Such workmen shall be paid no less than such general prevailing minimum wage rates and such other provisions to assure payment thereof as heretofore set forth in this Section.

3. The Contract provisions shall apply to all work performed on the Contract by the Contractor and to all work performed on the Contract by all Subcontractors.

4. The Contractor shall insert in each of its subcontracts all of the stipulations contained in these required provisions and such other stipulations as may be required.

5. No workmen may be employed on the public work except in accordance with the classifications set forth in the decisions of the Secretary. In the event that additional or different classifications are necessary, the procedure set forth in Section 7 of these Regulations shall be followed.

6. All workmen employed or working on the public work shall be paid unconditionally, regardless of whether any contractual relationship exists or the nature of any Contractor, Subcontractor and workmen, not less than once a week without deduction or rebate, on any account, either directly or indirectly, except authorized deductions, the full amounts due at the time of payment, computed at the rates applicable to the time worked in the appropriate classification. Nothing in the Contract, the Act, or these Regulations shall prohibit the payment of more than the general prevailing minimum wage rates as determined by the Secretary to any workman on public work.

7. The Contractor and each Subcontractor shall post for the entire period of construction the wage determination decisions of the Secretary, including the effective date of any changes thereof, in a prominent and easily accessible place or places at the site of the work and at such a place or places used by them to pay workmen their wages. The posted notice of wage rates must contain the following information:

   a. Name of project.

   b. Name of public body of which it is being constructed.

   c. The crafts and classifications of workmen listed in the Secretary's general prevailing minimum wage rate determinations for the particular project.

   d. The general prevailing minimum wage rates determined for each craft and classification and the effective date of any changes.

   e. A statement advising workmen that if they have been paid less than the general prevailing minimum wage rate for their job classification or that the Contractor and/or Subcontractor are not complying with the Act or these Regulations in any manner whatsoever, they may file a protest with the Secretary of Labor and Industry. Any workmen paid less than the rate specified in the Contract shall have a civil right of action for the difference between the wage paid and the wages stipulated in the Contract, which right of action must be exercised within six (6) months from the occurrence of the event creating such right.

8. The Contractor and all Subcontractors shall keep an accurate record showing the name, craft and/or classification, number of hours worked per day, and the actual hourly rate of wage paid (including employee benefits) to each workman employed by him in connection with the public work, and such record must include any deductions from each workman. The record shall be preserved for two years from the date of payment and shall be open at all reasonable hours to the inspection of the public body awarding the contract and to the Secretary or his duly authorized representative.

9. Apprentices shall be limited to such numbers as shall be in accordance with a bona fide apprenticeship program registered with and approved by the Pennsylvania Apprenticeship and Training Council, and only apprentices whose training and employment are in full compliance with the provisions of the Apprenticeship and Training Act approved July 14, 1961 (Act No. 304), and the Rules and Regulations issued pursuant thereto shall be employed on the public work project. Any workman using the tools of a craft who does not qualify as an apprentice within the provisions of this Subsection shall be paid the rate predetermined for journeymen in that particular craft and/or classification.

10. Wages shall be paid without any deductions except authorized deductions. Employers not parties to a contract requiring contributions for employee benefits which the Secretary has determined to be included in the general prevailing minimum wage rate shall pay the monetary equivalent thereof directly to the workmen.

11. Payment of compensation to workmen for work performed on public work on a lump-sum basis, or a piecework system, or a price certain for the completion of a certain amount of work, or the production of a certain result shall be deemed a violation of the Act and these Regulations, regardless of the average hourly earnings resulting therefrom.

12. Each Contractor and each Subcontractor shall file a statement each week and a final statement at the conclusion of the work on the Contract with the contracting agency, under oath, and in form satisfactory to the Secretary, certifying that all workmen have been paid wages in strict conformity with the provisions and if any wages remain unpaid to set forth the amount of wages due and owing to each workman respectively.

13. The provisions of the Act and these Regulations shall be incorporated by reference in the Contract.

END OF SECTION

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project Name:	New Bleachers, Press Box, Restroom Building and Parking Lot
Awarding Agency:	Penn State University
Contract Award Date:	5/15/2024
Serial Number:	24-02676
Project Classification:	Building/Highway
Determination Date:	3/18/2024
Assigned Field Office:	Harrisburg
Field Office Phone Number:	(717)787-4763
Toll Free Phone Number:	(800)932-0665
Project County:	Dauphin County

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-02676 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	6/26/2023		$38.70	$29.11	$67.81
Asbestos & Insulation Workers	7/1/2024		$35.80	$34.06	$69.86
Boilermakers	1/1/2023		$51.27	$35.30	$86.57
Boilermakers	1/1/2024		$52.10	$35.72	$87.82
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/30/2023		$38.27	$18.18	$56.45
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/28/2024		$40.12	$18.18	$58.30
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/4/2025		$41.97	$18.18	$60.15
Carpenters - Piledriver/Welder	1/1/2023		$40.63	$21.22	$61.85
Carpenters - Piledriver/Welder	1/1/2024		$42.13	$21.97	$64.10
Carpenters - Piledriver/Welder	1/1/2025		$43.38	$22.72	$66.10
Carpenters - Piledriver/Welder	1/1/2026		$44.63	$23.47	$68.10
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2023		$35.06	$17.72	$52.78
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2024		$36.56	$17.72	$54.28
Cement Finishers & Plasterers	4/30/2023		$28.23	$22.27	$50.50
Cement Finishers & Plasterers	4/28/2024		$30.23	$22.27	$52.50
Cement Finishers & Plasterers	5/4/2025		$32.23	$22.27	$54.50
Cement Finishers & Plasterers	5/3/2026		$34.23	$22.27	$56.50
Cement Masons	5/1/2023		$32.90	$22.70	$55.60
Drywall Finisher	5/1/2023		$30.10	$22.14	$52.24
Electricians	6/1/2022		$35.25	$26.31	$61.56
Electricians	6/1/2023		$37.00	$26.67	$63.67
Electricians	6/1/2024		$37.00	$30.51	$67.51
Electricians	6/1/2025		$37.00	$32.50	$69.50
Elevator Constructor	1/1/2023		$53.93	$38.34	$92.27
Elevator Constructor	1/1/2024		$60.76	$39.19	$99.95
Glazier	5/1/2023		$31.23	$20.66	$51.89
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2021		$34.01	$31.13	$65.14
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2023		$36.26	$31.38	$67.64
Laborers (Class 01 - See notes)	5/1/2023		$23.11	$18.03	$41.14
Laborers (Class 02 - See notes)	5/1/2023		$25.11	$18.03	$43.14
Laborers (Class 03 - See notes)	4/30/2023		$27.01	$18.22	$45.23
Laborers (Class 04 - See notes)	4/30/2023		$28.51	$18.22	$46.73
Laborers (Class 05 - See notes)	4/30/2023		$29.01	$18.22	$47.23
Laborers (Class 06 - See notes)	5/1/2023		$25.11	$18.03	$43.14
Marble Mason	5/1/2023		$34.80	$17.74	$52.54
Marble Mason	5/1/2024		$36.75	$17.74	$54.49
Marble Mason	5/1/2025		$38.70	$17.74	$56.44
Millwright	6/1/2023		$39.21	$22.95	$62.16
Millwright	6/1/2024		$41.07	$22.95	$64.02
Millwright	6/1/2025		$43.00	$22.95	$65.95

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-02676 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Millwright	6/1/2026		$44.97	$22.95	$67.92
Operators (Building, Class 01 - See Notes)	5/1/2023		$42.57	$29.24	$71.81
Operators (Building, Class 01A - See Notes)	5/1/2023		$44.82	$29.90	$74.72
Operators (Building, Class 02 - See Notes)	5/1/2023		$42.29	$29.15	$71.44
Operators (Building, Class 02A - See Notes)	5/1/2023		$44.54	$29.82	$74.36
Operators (Building, Class 03 - See Notes)	5/1/2023		$39.57	$28.34	$67.91
Operators (Building, Class 04 - See Notes)	5/1/2023		$38.42	$28.02	$66.44
Operators (Building, Class 05 - See Notes)	5/1/2023		$37.97	$27.89	$65.86
Operators (Building, Class 06 - See Notes)	5/1/2023		$37.10	$27.62	$64.72
Operators (Building, Class 07A- See Notes)	5/1/2023		$51.63	$33.34	$84.97
Operators (Building, Class 07B- See Notes)	5/1/2023		$51.28	$33.24	$84.52
Painters Class 1 (see notes)	5/1/2023		$27.02	$17.54	$44.56
Painters Class 2 (see notes)	5/1/2020		$27.43	$15.99	$43.42
Painters Class 3 (see notes)	5/1/2020		$33.18	$15.99	$49.17
Pile Driver Divers (Building, Heavy, Highway)	1/1/2023		$58.70	$21.22	$79.92
Pile Driver Divers (Building, Heavy, Highway)	1/1/2024		$60.95	$21.97	$82.92
Pile Driver Divers (Building, Heavy, Highway)	1/1/2025		$62.82	$22.72	$85.54
Pile Driver Divers (Building, Heavy, Highway)	1/1/2026		$64.70	$23.47	$88.17
Piledrivers	1/1/2023		$39.13	$21.22	$60.35
Piledrivers	1/1/2024		$40.63	$21.97	$62.60
Piledrivers	1/1/2025		$41.88	$22.72	$64.60
Piledrivers	1/1/2026		$43.13	$23.47	$66.60
Plasterers	5/1/2023		$31.33	$20.83	$52.16
Plumber/Pipefitter	5/1/2023		$41.36	$29.72	$71.08
Roofers (Composition)	5/1/2023		$42.63	$34.62	$77.25
Roofers (Shingle)	5/1/2023		$32.85	$22.10	$54.95
Roofers (Slate & Tile)	5/1/2023		$35.85	$22.10	$57.95
Sheet Metal Workers	6/1/2022		$40.22	$41.01	$81.23
Sheet Metal Workers	6/1/2023		$41.41	$42.32	$83.73
Sign Makers and Hangars	7/15/2022		$30.54	$24.35	$54.89
Sign Makers and Hangars	7/15/2023		$31.76	$24.63	$56.39
Sprinklerfitters	4/1/2023		$44.33	$28.04	$72.37
Terrazzo Finisher	5/1/2023		$35.79	$19.25	$55.04
Terrazzo Finisher	5/1/2024		$37.16	$19.26	$56.42
Terrazzo Grinder	5/1/2023		$36.54	$19.25	$55.79
Terrazzo Grinder	5/1/2024		$37.92	$19.26	$57.18
Terrazzo Mechanics	5/1/2023		$36.51	$21.00	$57.51
Terrazzo Mechanics	5/1/2024		$37.94	$21.01	$58.95
Terrazzo Setter	5/1/2019		$31.81	$19.67	$51.48
Tile & Marble Finisher	5/1/2023		$32.91	$15.49	$48.40
Tile & Marble Finisher	5/1/2024		$34.86	$15.49	$50.35
Tile & Marble Finisher	5/1/2025		$36.81	$15.49	$52.30
Tile Setter	5/1/2023		$34.80	$17.74	$52.54
Tile Setter	5/1/2024		$36.75	$17.74	$54.49

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-02676 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Tile Setter	5/1/2025		$38.70	$17.74	$56.44
Truckdriver class 1(see notes)	5/1/2021		$37.72	$0.00	$37.72
Truckdriver class 2 (see notes)	5/1/2021		$37.79	$0.00	$37.79
Truckdriver class 3 (see notes)	5/1/2021		$38.28	$0.00	$38.28
Window Film / Tint Installer	6/1/2019		$24.52	$12.08	$36.60

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-02676 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Carpenter	5/1/2023		$35.32	$19.09	$54.41
Carpenter	5/1/2024		$36.12	$19.79	$55.91
Carpenter	5/1/2025		$36.87	$20.49	$57.36
Carpenter	5/1/2026		$37.63	$21.18	$58.81
Carpenter Welder	5/1/2023		$36.07	$19.09	$55.16
Carpenter Welder	5/1/2024		$36.87	$19.79	$56.66
Carpenter Welder	5/1/2025		$37.62	$20.49	$58.11
Carpenter Welder	5/1/2026		$38.38	$21.18	$59.56
Carpenters - Piledriver/Welder	1/1/2023		$36.07	$19.09	$55.16
Carpenters - Piledriver/Welder	1/1/2024		$36.87	$19.79	$56.66
Carpenters - Piledriver/Welder	1/1/2025		$37.62	$20.49	$58.11
Carpenters - Piledriver/Welder	1/1/2026		$38.38	$21.18	$59.56
Cement Finishers	5/1/2016		$26.40	$22.35	$48.75
Electric Lineman	5/29/2023		$51.40	$29.62	$81.02
Electric Lineman	6/3/2024		$52.80	$30.61	$83.41
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2023		$36.26	$31.38	$67.64
Laborers (Class 01 - See notes)	5/1/2023		$24.81	$18.99	$43.80
Laborers (Class 01 - See notes)	5/1/2024		$25.61	$19.49	$45.10
Laborers (Class 02 - See notes)	5/1/2023		$31.43	$18.99	$50.42
Laborers (Class 02 - See notes)	5/1/2024		$32.23	$19.49	$51.72
Laborers (Class 03 - See notes)	5/1/2023		$28.42	$18.99	$47.41
Laborers (Class 03 - See notes)	5/1/2024		$29.22	$19.49	$48.71
Laborers (Class 04 - See notes)	5/1/2023		$28.77	$18.99	$47.76
Laborers (Class 04 - See notes)	5/1/2024		$29.57	$19.49	$49.06
Laborers (Class 05 - See notes)	5/1/2023		$29.44	$18.99	$48.43
Laborers (Class 05 - See notes)	5/1/2024		$30.24	$19.49	$49.73
Laborers (Class 06 - See notes)	5/1/2023		$28.86	$18.99	$47.85
Laborers (Class 06 - See notes)	5/1/2024		$29.66	$19.49	$49.15
Laborers (Class 07 - See notes)	5/1/2023		$29.15	$18.99	$48.14
Laborers (Class 07 - See notes)	5/1/2024		$29.95	$19.49	$49.44
Laborers (Class 08 - See notes)	5/1/2023		$29.63	$18.99	$48.62
Laborers (Class 08 - See notes)	5/1/2024		$30.43	$19.49	$49.92
Millwright	6/1/2023		$41.51	$23.33	$64.84
Millwright	6/1/2024		$43.46	$23.33	$66.79
Millwright	6/1/2025		$45.46	$23.33	$68.79
Millwright	6/1/2026		$47.52	$23.33	$70.85
Operators (Heavy, Class 01 - See Notes)	5/1/2023		$41.14	$28.82	$69.96
Operators (Heavy, Class 01 - See Notes)	5/1/2024		$42.30	$29.66	$71.96
Operators (Heavy, Class 01 - See Notes)	5/1/2025		$43.46	$30.50	$73.96
Operators (Heavy, Class 01 - See Notes)	5/1/2026		$44.61	$31.35	$75.96
Operators (Heavy, Class 01A - See Notes)	5/1/2023		$43.39	$29.48	$72.87
Operators (Heavy, Class 01A - See Notes)	5/1/2024		$44.55	$30.32	$74.87
Operators (Heavy, Class 01A - See Notes)	5/1/2025		$45.71	$31.16	$76.87
Operators (Heavy, Class 01A - See Notes)	5/1/2026		$46.86	$32.01	$78.87

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-02676 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Heavy, Class 02 - See Notes)	5/1/2023		$40.86	$28.73	$69.59
Operators (Heavy, Class 02 - See Notes)	5/1/2024		$42.02	$29.57	$71.59
Operators (Heavy, Class 02 - See Notes)	5/1/2025		$43.18	$30.41	$73.59
Operators (Heavy, Class 02 - See Notes)	5/1/2026		$44.34	$31.25	$75.59
Operators (Heavy, Class 02A - See Notes)	5/1/2023		$43.11	$29.40	$72.51
Operators (Heavy, Class 02A - See Notes)	5/1/2024		$44.27	$30.24	$74.51
Operators (Heavy, Class 02A - See Notes)	5/1/2025		$45.43	$31.08	$76.51
Operators (Heavy, Class 02A - See Notes)	5/1/2026		$46.59	$31.92	$78.51
Operators (Heavy, Class 03 - See Notes)	5/1/2023		$37.95	$27.86	$65.81
Operators (Heavy, Class 03 - See Notes)	5/1/2024		$39.11	$28.70	$67.81
Operators (Heavy, Class 03 - See Notes)	5/1/2025		$40.26	$29.55	$69.81
Operators (Heavy, Class 03 - See Notes)	5/1/2026		$41.43	$30.38	$71.81
Operators (Heavy, Class 04 - See Notes)	5/1/2023		$36.80	$27.54	$64.34
Operators (Heavy, Class 04 - See Notes)	5/1/2024		$37.96	$28.38	$66.34
Operators (Heavy, Class 04 - See Notes)	5/1/2025		$39.12	$29.22	$68.34
Operators (Heavy, Class 04 - See Notes)	5/1/2026		$40.28	$30.06	$70.34
Operators (Heavy, Class 05 - See Notes)	5/1/2023		$36.35	$27.41	$63.76
Operators (Heavy, Class 05 - See Notes)	5/1/2024		$37.51	$28.25	$65.76
Operators (Heavy, Class 05 - See Notes)	5/1/2025		$38.67	$29.09	$67.76
Operators (Heavy, Class 05 - See Notes)	5/1/2026		$39.83	$29.93	$69.76
Operators (Heavy, Class 06 - See Notes)	5/1/2023		$35.48	$27.14	$62.62
Operators (Heavy, Class 06 - See Notes)	5/1/2024		$36.64	$27.98	$64.62
Operators (Heavy, Class 06 - See Notes)	5/1/2025		$37.80	$28.82	$66.62
Operators (Heavy, Class 06 - See Notes)	5/1/2026		$38.96	$29.66	$68.62
Operators (Heavy, Class 07A - See Notes)	5/1/2023		$49.93	$32.83	$82.76
Operators (Heavy, Class 07A - See Notes)	5/1/2024		$51.39	$33.77	$85.16
Operators (Heavy, Class 07A - See Notes)	5/1/2025		$52.85	$34.71	$87.56
Operators (Heavy, Class 07A - See Notes)	5/1/2026		$54.32	$35.64	$89.96
Operators (Heavy, Class 07B - See Notes)	5/1/2023		$49.58	$32.73	$82.31
Operators (Heavy, Class 07B - See Notes)	5/1/2024		$51.04	$33.67	$84.71
Operators (Heavy, Class 07B - See Notes)	5/1/2025		$52.51	$34.60	$87.11
Operators (Heavy, Class 07B - See Notes)	5/1/2026		$53.97	$35.54	$89.51
Operators (Highway, Class 01 - See Notes)	5/1/2023		$40.25	$28.55	$68.80
Operators (Highway, Class 01 - See Notes)	5/1/2024		$41.41	$29.39	$70.80
Operators (Highway, Class 01 - See Notes)	5/1/2025		$42.56	$30.24	$72.80
Operators (Highway, Class 01 - See Notes)	5/1/2026		$43.72	$31.08	$74.80
Operators (Highway, Class 01a - See Notes)	5/1/2023		$42.50	$29.23	$71.73
Operators (Highway, Class 01a - See Notes)	5/1/2024		$43.66	$30.07	$73.73
Operators (Highway, Class 01a - See Notes)	5/1/2025		$44.81	$30.92	$75.73
Operators (Highway, Class 01a - See Notes)	5/1/2026		$45.97	$31.76	$77.73
Operators (Highway, Class 02 - See Notes)	5/1/2023		$39.08	$28.20	$67.28
Operators (Highway, Class 02 - See Notes)	5/1/2024		$40.24	$29.04	$69.28
Operators (Highway, Class 02 - See Notes)	5/1/2025		$41.39	$29.89	$71.28
Operators (Highway, Class 02 - See Notes)	5/1/2026		$42.55	$30.73	$73.28

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-02676 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Highway, Class 03 - See Notes)	5/1/2023		$38.39	$27.99	$66.38
Operators (Highway, Class 03 - See Notes)	5/1/2024		$39.55	$28.83	$68.38
Operators (Highway, Class 03 - See Notes)	5/1/2025		$40.70	$29.68	$70.38
Operators (Highway, Class 03 - See Notes)	5/1/2026		$41.87	$30.51	$72.38
Operators (Highway, Class 04 - See Notes)	5/1/2023		$37.94	$27.86	$65.80
Operators (Highway, Class 04 - See Notes)	5/1/2024		$39.10	$28.70	$67.80
Operators (Highway, Class 04 - See Notes)	5/1/2025		$40.26	$29.54	$69.80
Operators (Highway, Class 04 - See Notes)	5/1/2026		$41.41	$30.39	$71.80
Operators (Highway, Class 05 - See Notes)	5/1/2023		$37.42	$27.72	$65.14
Operators (Highway, Class 05 - See Notes)	5/1/2024		$38.58	$28.56	$67.14
Operators (Highway, Class 05 - See Notes)	5/1/2025		$39.73	$29.41	$69.14
Operators (Highway, Class 05 - See Notes)	5/1/2026		$40.89	$30.25	$71.14
Operators (Highway, Class 06 - See Notes)	5/1/2023		$40.48	$28.62	$69.10
Operators (Highway, Class 06 - See Notes)	5/1/2024		$41.64	$29.46	$71.10
Operators (Highway, Class 06 - See Notes)	5/1/2025		$42.80	$30.30	$73.10
Operators (Highway, Class 06 - See Notes)	5/1/2026		$43.95	$31.15	$75.10
Operators (Highway, Class 06/A - See Notes)	5/1/2023		$42.73	$29.28	$72.01
Operators (Highway, Class 06/A - See Notes)	5/1/2024		$43.89	$30.12	$74.01
Operators (Highway, Class 06/A - See Notes)	5/1/2025		$45.05	$30.96	$76.01
Operators (Highway, Class 06/A - See Notes)	5/1/2026		$46.21	$31.80	$78.01
Operators (Highway, Class 07/A - See Notes)	5/1/2023		$48.86	$32.51	$81.37
Operators (Highway, Class 07/A - See Notes)	5/1/2024		$50.32	$33.45	$83.77
Operators (Highway, Class 07/A - See Notes)	5/1/2025		$51.79	$34.38	$86.17
Operators (Highway, Class 07/A - See Notes)	5/1/2026		$53.25	$35.32	$88.57
Operators (Highway, Class 07/B - See Notes)	5/1/2023		$47.44	$32.10	$79.54
Operators (Highway, Class 07/B - See Notes)	5/1/2024		$48.91	$33.03	$81.94
Operators (Highway, Class 07/B - See Notes)	5/1/2025		$50.37	$33.97	$84.34
Operators (Highway, Class 07/B - See Notes)	5/1/2026		$51.84	$34.90	$86.74
Painters Class 1 (see notes)	5/1/2018		$23.92	$14.37	$38.29
Painters Class 2 (see notes)	5/1/2023		$29.15	$17.54	$46.69
Painters Class 3 (see notes)	5/1/2023		$34.90	$17.54	$52.44
Piledrivers	5/1/2023		$35.32	$19.09	$54.41
Piledrivers	5/1/2024		$36.12	$19.79	$55.91
Piledrivers	5/1/2025		$36.87	$20.49	$57.36
Piledrivers	5/1/2026		$37.63	$21.18	$58.81
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2022		$48.43	$40.28	$88.71
Truckdriver class 1(see notes)	5/1/2021		$37.72	$0.00	$37.72
Truckdriver class 2 (see notes)	5/1/2021		$37.79	$0.00	$37.79
Truckdriver class 3 (see notes)	5/1/2021		$38.28	$0.00	$38.28

SECTION E

LIST OF DRAWINGS

1. The following drawing(s) accompany this specification and are hereby made a part thereof.

Drawing No.	Dated	Revisions	Title
General			
G-001	2024/01/22		Cover Sheet
G-002	2024/01/22		Code Review
Civil			
C101	2024/01/22		Overall Existing Features Plan
C102	2024/01/22		Existing Features & Demolition Plan
C103	2024/01/22		Site Plan
C104	2024/01/22		Grading & Utility Plan
C105	2024/01/22		Erosion & Sedimentation Plan
C301	2024/01/22		Sanitary Sewer Profile
C501	2024/01/22		Details
C502	2024/01/22		Stormwater Management Details
C503	2024/01/22		E & S Details
Landscape			
L-101	2024/01/22		Overall Landscape Layout, Material and Planting Plan
L-501	2024/01/22		Landscape Details
Structural			
S001	2024/01/22		General Notes and Typical Details
S101	2024/01/22		Foundation Plan
S102	2024/01/22		Bleacher Slab Plan
S201	2024/01/22		Roof Framing Plan
Architectural			
A-001	2024/01/22		Life Safety Plan, General Notes Abbreviations & Symbols
A-002	2024/01/22		Accessible Mounting Heights
AE101	2024/01/22		Restrooms Bldg. Plans
AE201	2024/01/22		Exterior Elevations
AE202	2024/01/22		Building Sections
AE301	2024/01/22		Wall Sections & Details
AE302	2024/01/22		Wall Sections & Details
AE401	2023-10-04		Large Scale Plans & Interior Elevations
AE402	2024/01/22		Bleachers & Press Box Plans & Elevations
AE403	2024/01/22		Press Box Sections & Details
AE601	2024/01/22		Schedules, Legends & Details
Plumbing			
P001	2024/01/22		Symbols & General Notes-Plumbing
P101	2024/01/22		Floor Plans – Plumbing
Mechanical			
H-001	2024/01/22		Symbols & General Notes-HVAC
H-101	2024/01/22		Floor Plans – HVAC

Electrical		
E-001	2024/01/22	Symbols & General Notes-Electrical
E-010	2024/01/22	Site Plan – Electrical
E-101	2024/01/22	Floor Plans – Electrical
E-501	2024/01/22	Lighting Details & Schedules
E-601	2024/01/22	Power Details & Schedules

SECTION F

GENERAL CONDUCT OF THE WORK AND SPECIAL REQUIREMENTS

F-01 General

A. This section contains special instructions relating to the execution of the work shown on the drawings and required by the specifications, and is applicable to all Contracts.

F-02 Definitions

A. Wherever the Contract Documents contain the terms "work," "building," "structure," "project," or words like import are used, it shall be understood to refer to and designate all construction materials and labor, complete and ready for use, within the limits of the contract lines as shown on the plot plan and specified.

B. "Provide" as used in the specification documents shall be understood to mean furnish and install complete and ready for use.

F-03 Project Coordination

A. The General Contractor shall be responsible for the overall coordination, control, and progress of the work for all of the other Prime Contractors, Subcontractors, and material suppliers involved in the project.

B. The General Contractor shall also be responsible for preparing the progress schedule indicating the sequence and time required for the varied disciplines of the work. The progress schedule shall be submitted by the General Contractor to the other Prime Contractors requesting their sequence and time requirement input. The Prime Contractors will be required to either approve the progress schedule submitted by the General Contractor or give comments for correction.

After approval by all Prime Contractors, one progress schedule showing all disciplines shall be prepared. The completed progress schedule shall then be submitted to the Professional for review and approval. The approved progress schedule shall then be issued by the General Contractor to all Prime Contractors, the Professional, and the University.

F-04 Project Meetings

A. Preconstruction Conference. Prior to commencement of the work, the Contractors shall meet in conference with representatives of the Owner, to discuss and develop mutual understanding, relative to administration of the project, general conduct of the work, progress schedules, safety programs, labor provisions, and other contract procedures relating to the work.

B. The General Contractor shall provide a space to conduct a regularly scheduled, biweekly (every two weeks) meeting at the site for the purpose of coordinating the work. The General Contractor shall require representation from all Prime Contractors and by any Subcontractors upon request of the Professional or the University.

C. Contractors shall attend personally or be represented at such meetings. Should the Contractor elect to be represented, it shall be understood and agreed that the University and the Professional, in dealing with contractor's representatives, do so with full assurance that such representative's actions and commitments may be accepted the same as though the contractor who signed, and is bound by the contract, were itself present and personally made such agreements or commitments.

D. The Professional shall take and retain a verbatim record of the biweekly meeting and shall prepare and distribute summary minutes of each meeting within four (4) days to the University, the Contractors, and all other interested parties. Any corrections to the minutes are to be sent to the Professional within four (4) working days after receipt of same.

F-05 Order of Work

A. If in the judgment of the University, it becomes necessary at any time during construction to expedite the work or any part of it to conform with the approved project schedule, the Contractor shall cease work at any location, transfer its men to other locations, and execute other portions of the work as may be directed.

F-06 Parking for Contractors' Employees

A. Parking will be assigned by the University.

B. Each Contractor shall arrange for transportation between the assigned parking area and the project site.

F-07 Unclassified Excavation

A. All excavation work will be unclassified and will include (without limitation thereto) the excavation and removal of all soil, shale, rock or rock formations, boulders, existing foundations, fill, and any type of subsurface condition encountered.

B. The University will consider no claims for extra compensation or extension of time because of the nature and subsurface conditions encountered.

F-08 Blasting

A. Because of experimental work being done in certain buildings on the campus and because laboratory equipment can be damaged or destroyed by unexpected vibrations due to blasting operations, it will be necessary for the Contractor doing blasting to conform to an established procedure which is in effect on the campus. It is not anticipated that blasting will be required on this project; however, should this event occur, the procedure will be made available to the Contractor.

F-09 Protection of Property

A. Protect all trees, shrubs, lawn areas, curbing, walks, roadways, and ground areas from damage during the course of the construction. Protect the existing structures and Contractors shall use care in the work in general in, on, and around the structures. Repair all damage to the satisfaction of the University at the responsible party's cost and expense.

F-10 Warning Lights

A. Where warning lights are required, they shall be the blinker type, battery or electrically operated. Open-flame-type torches are not permitted.

F-11 Access

A. Each Contractor shall maintain unobstructed pedestrian and automobile traffic lanes on the campus roads, service drives, and parking areas.

B. Protect existing buildings and structures from damage. Take all precautions to avoid damaging utilities.

C. The General Contractor shall cover all stairs, treads, and risers, immediately after erection with heavy building paper, on top of which shall be placed boards, securely fastened in place, until project completion.

D. Each Contractor shall provide constant protection against rain, wind, storms, frost, or heat so as to maintain his work, materials, apparatus, and fixtures free from damage. At the end of each day's work, cover work likely to be damaged. During cold weather, protect work from damage by freezing and provide such enclosures and heating apparatus as may be necessary to prosecute the work without stoppage for reason of unfavorable weather.

E. Each Contractor, in all areas of operations, shall provide barricades, guard lights, and other appurtenances for the protection of workmen and public as required by applicable regulations and for the protection of roads, lighting, hydrants, walks, curbs, and adjacent grounds and planting for the duration of such operations. The Contractor shall bear the costs of damage caused by it and/or its Subcontractors.

F-12 Construction Fence

A. The General Contractor shall be required to provide a construction fence enclosing the area of the work within the central limits. Construction fencing is also required for trailers and stored material that may be located outside the area of work. Fencing material should be adequate to protect persons and property.

1. Provide a six foot high (6') chain-link fence with galvanized frame and fabric, and adequate gates as required. Posts shall be 2 inch dia and spaced at maximum of 8 feet OC. Anchor posts in concrete footing. Footing shall be 10 inch diameter, with bottom at 36 inches below grade. Place tops of footing 3 inches below grade and cover with soil. Embed posts 24 inches in concrete. Provide top stabilizing rail between posts. Top of posts shall be closed.

2. Provide 5’–6” mesh fabric windscreen, mount top of fabric to top stabilizing bar. Fabric shall be PVC vinyl coated polyester, equal to Tenn-air curtain style, color US Open blue as manufactured by M. Putterman and Co., Inc. (800) 621-0146. Windscreen shall have reinforced hems and grommets every 12 inches on all edges. Install windscreen on construction side of fence, using 50-pound break strength tie wraps at every grommet. Pull fabric taught. (Optional: Penn State Logo shall be imprinted on windscreen facing the non-construction side of the fence at the request of the Project Manager.)

F-13 Temporary Facilities

A. Offices. The General Contractor may erect a temporary office where directed. It shall be adequate in size for conducting the work, accommodating project meetings, and shall contain a plan-table and plan-rack available for use by the University's representative(s).

B. Sheds. The Contractor may provide and erect temporary sheds, as directed, for the storage of tools, equipment, and materials.

C. Toilets. The Contractor shall provide, erect, and maintain adequate toilet facilities for the convenience of workmen and others employed on the work. The University shall approve the type of facility and location.

D. Scaffolding and Staging. The Contractor shall furnish and erect all ladders, staging, and scaffolding required.

E. Design. The University shall approve the design and appearance of offices, sheds, and toilets prior to erection.

F. Removal. Prior to completion of the work, the Contractors shall completely remove the temporary buildings, offices, sheds, toilets, scaffolding, etc., and all other items of temporary facilities and construction provided by them, and restore the area to the original condition acceptable to the University.

F-14 Existing Underground Utilities

A. The existence and locations of underground utilities indicated on the drawings are not guaranteed. The Contractor shall investigate and verify in the field before starting any work.

B. All excavation within three (3) feet of any existing underground utility line shall be accomplished by hand labor. Extreme caution shall be used in this area to prevent any damage to existing facilities.

C. The Contractor shall adequately protect from damage (including shoring, if necessary), all underground utilities uncovered or exposed. The Contractor shall be responsible for all damage to existing underground utilities caused by its work and shall repair by a method approved by the University.

D. Utilities serving existing buildings, installation, or facilities shall not be interrupted until the Contractor has made the necessary arrangements with and has received approval from the University.

E. In the event that interruption of any existing utility service is necessary, the responsible Contractor shall be required to make all arrangements for shutdown and start-up of such service with the University representative.

F-15 Temporary Utility Services

A. Each Contractor shall, at its own cost and expense, install, operate, protect, and maintain the respective temporary services as hereinafter specified, during the construction period of the entire project. These temporary services shall include water supply, electric light and power, temporary heat, material hoists, sanitary facilities, access roads, and any other services as may be stipulated in the General Conditions, Special Requirements, and/or specifications.

B. Temporary or permanent connections made by any Contractor to existing University systems shall be approved by the University, as to location and the manner and time of the connections to such systems. Where such connections require shutdown of an existing University system, the shutdown will be performed by the Contractor. A written advance notice of at least fourteen (14) days shall be given to the University by the Contractor requesting the shutdown. Directly after the final connection, reinstatement will be done by the Contractor.

C. Temporary connections to new and/or existing permanent service lines shall be made at locations as directed by the University, protected while in use, and when the temporary service lines are no longer required, they shall be removed by the Contractor. Any part or parts of the permanent service lines, grounds and buildings, disturbed or damaged by the installation and/or removal of the temporary service lines shall be restored to their original condition by the Contractor responsible for the temporary installation by a method approved by the University.

D. All underground utilities or service lines uncovered or exposed by the operations under this contract shall be adequately protected by the Contractor, who shall be responsible for the repair of any damage to such services. Services and utilities in and to existing buildings must not be connected to or interrupted without making the necessary written requests to the University and receiving written permission. All interruptions to University services must be scheduled two (2) weeks in advance and will generally be made outside of normal working hours.

E. Temporary heat shall be provided by each Contractor as required for its use and at its cost and expense. Electric power from University sources shall not be used for temporary heat.

F. Water will be available to all Contractors at no cost, at a hose bib located near the job site. Contractors shall provide, at their own cost and expense, all required extensions of existing facilities.

G. Temporary construction power and lighting shall be provided by each Contractor for its use at its own cost and expense.

H. Any Contractor who fails to carry out its responsibility in supplying temporary services, as set forth in its contract, shall be held responsible for such failure, and the University shall have the right to take such action as it deems proper for the protection and conduct of the work and shall deduct the cost involved from the amount due the Contractor.

F-16 Electric Power Equipment

A. Due to the limited capacity of electric distribution on the Campus, the use of A.C.-powered welders and electric heaters is prohibited.

F-17 Temporary Sanitary Facilities

A. Sanitary facilities will not be provided by the Owner. The use of Owner's facilities is prohibited (unless prior approval is granted by the Owner).

B. The General Contractor shall, at its own cost and expense, provide, operate, and maintain in a clean and sanitary conditions, adequate sanitary facilities as approved by the Owner.

1. All sanitary facilities shall be fully enclosed buildings, screened against insects.

2. Open-pit type facilities will not be permitted.

3. The Plumbing Contractor shall install and maintain in operation a sufficient number of nonfreeze-type fixtures in a manner approved by the Owner.

4. When directed by the Owner, the Contractor shall dismantle and remove these facilities and leave the premises clean as required.

5. As soon as permanent soil lines have been installed inside the building, the Plumbing Contractor shall install two temporary water closets and two lavatories. These shall be kept in working order by the Plumbing Contractor and shall be maintained in a clean and sanitary condition by the General Contractor.

6. The use of self-contained "Job-Johnny" units will be permitted upon approval by the Owner.

F-18 Existing Underground Service and Utility Lines

A. Notification to Public Utilities Prior to Excavation or Demolition Work When Using Powered Equipment or Explosives.

1. All Contractors shall comply with all requirements of the Act of December 10, 1974 (P.L. 852, No. 287), referred to as the Underground Utility Line Protection Law, as amended by the Act of December 12, 1991 (Act No. 1991-38), prior to excavation or demolition work when using power equipment or explosives.

B. At all locations, all underground utilities or service lines uncovered or exposed by the operations under the contract shall be adequately protected by the Contractor, who shall be responsible for the repair of any damage to such services. Contractor shall be responsible to the Owner for all costs resulting from the Contractor's damage to University lines. These include, but are not limited to material cost, wages, supervisory professional costs, disruption of services, research, and overhead costs. Contractor must notify the University immediately of any damages to utility lines and street lighting. Repairs shall be made by a method approved by the University.

F-19 Interruption of Existing Services

A. Utilities serving existing buildings, installations, or facilities shall not be interrupted until the Contractor has made the necessary arrangements with and has received approval from the University.

B. In the event that interruption of any existing utility service is necessary, the responsible Contractor shall be required to make all arrangements for shutdown and start-up of such service with the University representative, and shall pay all costs for such interruption and service restoration.

C. All planned interruptions to University services must be scheduled two (2) weeks in advance and the work will generally be done outside of normal working hours.

F-20 Laying Out the Work

A. The General Contractor shall employ a competent, experienced engineer and have the engineer determine all lines and grades and certify same from time to time during the progress of the work.

1. The General Contractor shall establish bench marks referenced to finished grade lines and critical elevations.

2. Each Prime Contractor or Subcontractor shall provide a competent engineering service to lay out its work in accordance with lines and grades established by the General Contractor.

F-21 Measurements

A. Before ordering material or proceeding with the work, the Contractors shall verify all measurements at the site. No extra compensation will be allowed because of differences between actual measurements and dimensions shown, but such differences shall be referred to the Professional for consideration before proceeding with the work.

F-22 Clearing of Roads, Parking Areas, and Traffic on Campus

A. The General Contractor shall daily clean all mud, dirt, and debris resulting from all Contractors' operations from the adjacent streets, sidewalks, drives, and parking areas, and shall repair all damage caused by the cleaning. If the Contractor fails to clear mud and construction debris from roads and walks, the University will clear this mud and debris and bill the Contractor(s) at cost.

B. All traffic will be subject to the rules and regulations and penalties of its University and applicable local laws. All hauling and construction traffic shall use only those roads designated by the University. The use of Jake Brakes on campus is prohibited.

C. Contractors shall carefully schedule delivery and installation of its work so to cause the least interruption of normal rush-hour traffic.

D. The General Contractor shall maintain streets, sidewalks, and driveways free of encumbrance at all times for pedestrian and automotive traffic. When necessary to block these off, do so only with prior approval of the University and only at designated time. Each closing must have the prior approval of the University.

E. Parking for Contractors' employees is prohibited on campus roads, drives, and courts.

F. Where mud, snow, ice, or other hazardous conditions exist, the General Contractor shall remove the hazards or shall provide and maintain such temporary pathways as are required for safe and expeditious prosecution and inspection of the work of all trades.

F-23 Cleanup

A. The General Contractor shall take precautions against the presence of rats, mice, and other pests. The General Contractor shall exterminate them if they are observed, engaging a reputable exterminating firm to give regular service as necessary.

B. Each Contractor shall keep the premises clean at all times of dirt, rubbish, and debris resulting from the work of all contracts, and shall remove all rubbish and debris in metal containers at the end of each working day. Each Contractor shall remove all rubbish and cartons resulting from the installation of fixtures and equipment. Disposal of materials by burning at the site is expressly prohibited. The Contractor will not use the University's trash collecting containers.

C. Prior to substantial completion of the work, each Contractor and Subcontractor shall do the final cleaning of the surfaces of all the Contractor's installations as may be required by the various specification sections.

D. Each Contractor, in addition, shall employ a professional cleaning organization to remove all paint and stains from glass and to wash all glass throughout the work, to clean and polish the finished surfaces of all fixtures, equipment, and accessories and to vacuum clean all floors.

E. All permanent equipment used to supply temporary services shall be completely cleaned and reconditioned by the appropriate Contractor prior to final acceptance by the University. Filters shall be in clean condition, interiors of all strainers shall be replaced or cleaned and seats on all valves and diaphragms on all traps of all sizes of the used portions shall be examined, cleaned, and replaced as necessary to the satisfaction of the University. Costs of cleaning, reconditioning, and replacement of parts of the permanent systems shall be at the expense of the responsible Contractor.

F. If a Contractor fails to clean up, the University may do so and the cost thereof shall be charged to the Contractor as provided in the General Conditions.

F-24 Existing Facilities

A. The University will maintain activities and normal office hours in the building during the course of this construction project. Difficulties of working in an existing operational building are recognized; however, the Contractor must cooperate to keep noise, dirt, and other interferences to a minimum. Housekeeping shall be such to assure no disruption of the University's operations and the Contractor shall schedule his work well in advance and give notice to all building occupants of any disruption.

B. Existing facilities must be maintained watertight and dust free at all times. The Contractors shall make all necessary provisions to this end and shall be responsible for any damage resulting from noncompliance with this requirement.

F-25 Requirements During Construction

A. Fence open ditches. Where walks cross such ditches, bridged walkways must be provided with rails on both sides. Bridged walkways must be adequately lighted at night.

B. Service temporary walks and roads with No. 2 crushed stone if they are to be in public use.

C. Walks and roadways used by both Contractor and the public shall be kept in repair and cleared by the Contractor at least once each day and more often as conditions require.

D. Place no obstructions on or within fifteen (15) feet of fire hydrants. Hydrants must be accessible for fire fighting purposes.

E. Protect and attend any type of temporary heating units used.

F. Where walkways, roadways, or entrances used by the public are adjacent to or pass under construction scaffolding or near building edge, the Contractor shall provide an adequate covering for such area to protect passersby from falling objects.

G. All temporary construction sheds, trailers, and flammable liquid storage areas belonging to Contractors shall be so placed on the construction site to minimize any danger to University property and the public.

H. The University Department of Environmental Health and Safety is available for consultation regarding the above items and any other safety matter.

F-26 Protective Barricades

Contractors shall be aware that the University community includes many people with disabilities (visually impaired, wheelchair-bound, etc.), requiring extra attention on the part of the Contractor to assure that construction work is properly identified and protected. The following provides minimum protective measures to be followed by Contractors doing work beyond the main project construction fence in order to protect the general public from hazards created by open excavations, manholes, etc.:

A. Any excavations outside the project fence shall be adequately protected to prevent falls, injury, or other hazard to the general public and University population, as follows:

1. Excavations for the purpose of constructing/installing manholes, meter pits, valve pits, or similar appurtenances must be completely surrounded by a rigid fence (not flagging tape or plastic netting) of sufficient height and strength to prevent individuals from crossing into the excavated area. Such fencing shall incorporate toeboards around the bottom and must be positioned and sufficient distance from the top of excavation to provide adequate protection against undermining or sloughing off of the excavation slopes.

2. Ditch excavations, such as for electrical, water, sewer, steam, gas, or other underground utility lines, shall, as a minimum, be protected on all sides with snow fencing or similarly strong material; fencing shall be positioned a safe distance away from the top of slope of the excavation.

B. Construction equipment used for hoisting men or materials (e.g., cranes and "cherrypickers," construction line trucks, mobile platforms, etc.) must be surrounded by appropriate protective barricades, safety lines, and signage to alert passersby of the presence of overhead loads and to provide adequate clearance around all boom swing areas, tail swing areas, overhead loads, and operating machinery. Passersby shall not be permitted to travel beneath suspended loads under any circumstances. If necessary, Contractor shall provide a flagman to assure safe passage of pedestrian and vehicular traffic.

C. Open manholes must be protected at all times by a rigid, fence-type barricade around the opening.

D. Flagging tape and traffic cones are not, under any circumstances, suitable or permissible barricading materials.

E. Contractors shall notify--and receive approval from--the University's Construction Inspection Office prior to beginning any excavation or opening of any manholes outside the project fence. The Inspection Office will then advise the appropriate University office of the hazardous condition, including location, approximate starting time, and expected duration of the situation.

F. Contractors shall report immediately to the University's Construction Quality Representative any accident or other incident, no matter how minor, which involves any member of the general public.

F-27 Delivery and Storage

A. On-Site. All materials and equipment shall be delivered to the site and stored at locations approved by the University. Each Contractor shall be responsible for proper care and protection, and shall protect and be responsible for any damage to its work or materials from the date of the Agreement until final payment is made, and shall make good without cost to the University any damage or loss that may occur during this period. All cement, lime, and other materials which may be affected by the weather shall be covered and protected to keep them free from damage while they are being transported to and stored on the site. Should any materials be found defective or in any way contrary to the Contract, this material, no matter in what stage of completion, may be rejected by the Professional and/or the University and shall be removed from the site at once.

B. Inside Building. In no case shall any materials be stored in mechanical and electrical spaces, nor shall any paint or other combustible supplies, tools, or equipment be stored in the building, except in tightly sealed metal containers, in well-ventilated spaces, and in a quantity limited to that day's need.

C. Provisions for Large Items. The General Contractor shall make provisions for bringing into the building large items of equipment by leaving temporary openings for them as determined to be required. After the equipment is set in place, the General Contractor shall close the opening as required.

D. Materials must be stored in such a way as not to damage existing structures or surrounding area. Any material or equipment stored on the roof of any building must be placed on dunnage and not directly on roof surface.

F-28 Fire Protection

A. Each Contractor shall maintain and enforce regulations covering all fire hazards, including smoking, and shall provide during construction, the required number of suitable fire extinguishers in the proper locations.

B. No fires for any purpose shall be permitted on the project. Remove all refuse from University property.

C. No welding, cutting by torch, or work utilizing or causing inflammable wastes shall be done unless adequate fire protection is provided and maintained for the duration of the work in the area of operations. University welding/cutting permits will be required and shall be issued at no cost to the Contractor by the University.

F-29 Job Site Security

A. The University will not provide job site security.

B. The University assumes no responsibility for damage or loss to the Contractors' property.

F-30 Dewatering

A. The General Contractor shall assume responsibility for continuous removal of all water, including surface and rainwater, by the use of pumps, drains, and other approved methods necessary to keep the excavation and site free from water at all times until completion.

B. All water must be directed away from existing structures, shall cause no erosion and shall prevent foreign material from backing up existing drains or entering into the sewers.

F-31 Fastening Devices

A. Fiber, plastic, lead plugs and shields, and any devices using wood screws are not acceptable as fastening devices to plaster, tile, concrete, or masonry. Use expansion bolts or driven devices in solid construction, and toggle bolts in hollow construction.

F-32 Welding

A. All welding and cutting shall be done by qualified and certified welders. Certificates shall be filed with the Professional and the University prior to commencement of any welding.

F-33 Noise Control

A. In most instances, noise control will be a matter of prime concern. It is, therefore, mandatory that all equipment such as compressors, generating equipment, etc., shall be fitted with mufflers or other noise abatement attachments.

B. It may become necessary to schedule some operations during periods of low occupancy of neighboring buildings.

F-34 Provision for People with Disabilities

A. All structures designed for general use, shall comply with all local, state, federal, and University regulations for facilities to accommodate people with disabilities.

F-35 Asbestos Removal

A. The University has an ongoing asbestos identification and removal program. On renovation projects where the possibility exists that material containing asbestos fibers may be encountered, the situation will be reviewed by the University and a course of action determined.

B. Possible asbestos removal situations will be discussed between the Professional and the University on a project-by-project basis.

C. If asbestos is found to be present after construction is underway, the University Construction Inspection Office is to be notified immediately so that proper removal work can begin promptly. Removal or repairs will then be initiated following all applicable EPA and OSHA regulations.

F-36 Advertising Signs

A. Neither the Professional nor Contractor shall erect advertising signs.

F-37 Project Sign

A. On projects funded solely by the University, a project sign shall be prepared and erected by the General Contractor and shall conform to the Specifications provided by the University.

B. The appropriate project name shall be inserted.

F-38 Warranty Period

A. During warranty periods, the University will respond to emergency situations, that is, situations determined to be potentially harmful to the surrounding personnel, equipment, or environment. In cases where work is performed by University employees, the Contractor will be charged for all labor and material needed to complete emergency repairs, if the repairs are determined to be the result of faulty material or workmanship. The performance of these repairs shall not void any Contractor's warranties.

B. The University will begin preventive maintenance programs immediately following final inspections. Preventive maintenance activities shall not relieve the Contractor from any equipment warranties.

F-39 Schedules and Reports

A. Refer to General Conditions of the Contract, Article 11, for a detailed breakdown of information required.

B. Together with each monthly application for payment, the Contractor shall forward to the University a summary report of the progress of the divisions of the work.

F-40 Confined Spaces

A. All Contractors will have a written OSHA compliant permit-required confined space program.

F-41 Demolition Work

A. Contractor is responsible for PA DEP/EPA notifications required for demolition work. Paperwork must be submitted to the Owner for review prior to submission to the proper agencies. Notification form templates are available from the Owner.

B. Demolition Contractor performing work requiring notifications must be prequalified by the Owner.

SECTION G

BASIS OF BIDS
FOR
CONTRACT NO. 1, GENERAL CONSTRUCTION

G-01 General Requirements

A. Under the bidding items listed herein, the Bidders shall submit responses in e-Builder for each Bid Item listed.

B. All requirements specified hereinafter for Contract No. 1, General Construction, shall govern, unless stated otherwise under any of the following Bid Items.

G-02 Basis Of Bid For Bid Items:

A. **Base Bid Item No. 1** shall be the lump sum price for the entire work for the Restroom Building and all site work in accordance with the requirements specified hereinafter for Contract No. 1, General Construction, complete and ready for use.
B. **Base Bid Item No 2** shall be the lump sum price to furnish and install the bleacher seating portion of the project.
C. **Base Bid Item No 3** shall be the lump sum price to furnish and install the press box portion of the project.
D. **Bid Alternate No 1** shall be the lump sum price to add and install landscape material in accordance with the requirements specified hereinafter for Contract No. 1, General Construction, complete and ready for use.
E. **Bid Alternate No 2** shall be the lump sum price to install the screen in front of the restrooms in accordance with the requirements specified hereinafter for Contract No. 1, General Construction, complete and ready for use.
F. **Bid Alternate No. 3**. Shall be the lump sum price to perform soil testing per PA DEP Management of Fill Policy to determine the necessary characteristics of excess soil materials on site.
G. **Unit Price No.1** shall be the Cost per Cubic Yard to haul off site and dispose of soil classified as Clean Fill assuming a minimum of 100 CY to be removed.
H. **Unit Price No.2** shall be the Cost per Cubic Yard to haul off site and dispose of soil classified as Residual Waste assuming a minimum of 100 CY to be removed.
I. **Unit Price No. 3** shall be the Cost per Cubic Yard to haul off site and dispose of soil classified as Hazardous Waste assuming a minimum of 100 CY to be removed.

G-03 Notice

A. The e-Builder Bid Package and the project specifications shall be used by the Bidders in submitting their proposal.

SECTION H

SCOPE OF THE WORK

H-01 General

A. This work shall be done in strict accordance with the Contract Documents prepared by Weber Murphy Fox, Inc. for The Pennsylvania State University, Owner.

B. All construction shown on the contract drawings and not expressly mentioned in the specifications and all work specified and not shown on the drawings, but obviously necessary to the proper execution of same, shall be performed by the Contractor, as it is not the intent to delineate or describe every detail and feature of work. No additions to the contract sum will be approved for any materials, equipment, and/or labor to perform work hereunder unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications and absolutely essential to the proper prosecution of the work.

C. Work under this contract consists of the complete construction work and includes, but is not necessarily limited to, the furnishing of all labor, superintendence, material, tools, and equipment necessary to complete all the work as shown on the contract drawings and as specified hereinafter.

H-02 Work By Others

A. Fiber optic wiring pulled by PSU from the existing communication manhole on the East side of College Avenue to the Concessions Building IT Rack, and the Pressbox IT Rack.

H-03 Grades, Lines, Levels, and Surveys

A. All grades, lines, levels, and bench marks shall be established and maintained by the Contractor, who shall verify all grades, lines, levels, and dimensions shown on the drawings, and shall report any errors or inconsistencies on the documents to the Professional before commencing work.

H-04 Coordination

A. The General Contractor shall coordinate all work on the project so as to insure the proper incorporation, within the project, of all necessary items and to insure the proper execution of the work.

H-05 Regulations

A. The established standards, rules, and regulations listed in these specifications are a part of the specifications and shall have the same force as if printed herein in full. The latest revisions at the time of construction shall be used.

End of section

H-06 Earthwork and removal of excess spoils

A. It will be the GC's responsibility, prior to removal of excess spoils, to have the soil material tested per the PA DEP Management of Fill Policy, and coordinate with PSU Project Management.

- http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=1526726&DocName=MANAGEMENT%20OF%20FILL.PDF%20%20%3cspan%20style%3D%22color:green%3b%22%3e%3c/span%3e%20%3cspan%20style%3D%22color:blue%3b%22%3e%3c/span%3e

End of section

PennState
Physical Plant

Office of Physical Plant
Physical Plant Building
University Park, PA 16802-1118

CONTRACTOR SAFETY REQUIREMENTS

1.0 PURPOSE:

The Pennsylvania State University endeavors to provide a safe and healthy environment for all students, employees, and visitors. Likewise, the University seeks to facilitate the creation and maintenance of a safe and healthy work environment on all work sites, construction and maintenance alike. This document establishes a framework of safety and health requirements that must be met during all phases of work activities at the University.

The Contractor and its subcontractors are responsible for the safety of its employees and all persons on and around a work site. The Contractor is solely responsible for the development and implementation of its own safety program. This document does not relieve, in any way, the duty and responsibility of Contractors, subcontractor, their agents and employees, and other persons performing portions of the Work on the Project to comply with all requirements of Public Law 91-596, the Occupational Safety and Health Act of 1970 ("OSHA"), 29 U.S.C. § 651 et. seq., and all amendments thereto, and any other applicable federal, state or local laws or regulations that address or relate to work site safety.

2.0 SCOPE:

This document provides Contractors with the University's specific requirements that must be incorporated into the Contractor's safety program. This document is not designed nor intended to replace the Contractor's safety program, nor to address every possible safety, environmental, or health issue. In the event that the Contractor's safety program includes a requirement or practice that is more stringent than set forth herein, the provision of the Contractor's safety program shall be followed. This document does not relieve the Contractor of its obligations to: (1) control the means and methods by which its employees, and any subcontractors, shall perform the Work; or (2) independently ascertain what health and safety practices are necessary for the performance of the Work.

This document applies to all Contractors who are awarded a Contract or Purchase Order by the Office of Physical Plant to perform Work at The Pennsylvania State University or any of its campuses. This document does not apply to Work performed at the Penn State Milton S. Hershey Medical Center unless noted otherwise.

No specific requirements herein shall be construed to limit, replace or supersede applicable provisions of federal, state or local laws or regulations that relate to work site safety.

3.0 DEFINITIONS:

Competent person: Defined by OSHA as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them". [29 CFR 1926.32(f)]. By way of training and/or experience, a competent person is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, and has the authority to correct them.

Confined Space: is a space that means a space that:(1) Is large enough and so configured that an employee can bodily enter it;(2) Has limited or restricted means for entry and exit; and (3) Is not designed for continuous employee occupancy. These spaces may also be classified as permit required confined spaces if they meet the definition of a permit required confined space. See 1926.1200 for additional information and guidance.

Contract / Contract Documents: The contract or purchase order, including as applicable any general conditions, drawings, specifications, addenda, or other documents listed or referenced in the contract or purchase order, and any modifications thereof, which specify the Work to be performed on the Project.

Contractor: The party named in the contract agreement who will execute the Work (Contractor/Construction Manager) and who shall be responsible for the proper completion of the Project. When not otherwise specified herein, the term “Contractor” shall include subcontractors of any tier, agents and employees of contractors or subcontractors, and any persons engaged to perform Work on the Project.

Near Misses: Unplanned events that did not result in injury, illness, or damage, but had the potential to do so. In the case of a near miss, injury, fatality or property damage was averted only through a fortunate break in the chain of events.

Permit Required Confined Space: means a confined space that has one or more of the following characteristics: (1) Contains or has a potential to contain a hazardous atmosphere; (2) Contains a material that has the potential for engulfing an entrant; (3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or (4) Contains any other recognized serious safety or health hazard.

Project: The building, facility or property, that is to be constructed, altered, repaired or improved, as specified in the Contract Documents.

Qualified Person: - One who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the Project.

Site Specific Safety Plan ("SSSP"): The procedures and requirements that must be prepared for each Project, per the template set forth at Appendix A, in order to establish a Project-Specific Safety Plan and to address job- specific hazards that could impact workers on the Job and the University Community. Safety plans are custom made documents that can be amended and changed based upon the hazards of the workplace.

Subcontractor/Trade Contractor: Where "subcontractor/trade contractors" is referenced, this includes all trade contractors, subcontractors and lower tier subcontractors engaged to perform work on the Project.

University: The Pennsylvania State University and representatives/agents of the University. Also referred to herein as "Penn State" or "Owner."

University Community: This includes but is not limited to employees, students, visitors to Penn State University premises, and any contractors performing work on University controlled property.

Work - The construction and services necessary or incidental to fulfill the Contractor's obligations for the Project in conformance with the Contract Documents, including the furnishing of labor and services to perform construction, alteration, demolition and/or maintenance/repair, including painting and decorating.

4.0 Responsibilities

4.1 Contractor

4.1.1 The Contractor is responsible for maintaining and implementing its own safety program and meeting the University's Contractor Safety Requirements.

4.1.2 The Contractor is solely responsible for the safety of all persons on or near to the work site and for all property in proximity thereto and must take all necessary steps to ensure a safe work site.

4.2 University

4.2.1 The University is committed to helping the Contractor meet its goals of a safe, healthy and productive work site.

4.2.2 Nothing herein shall be construed as providing the University with the right *or responsibility* to control the manner, method and operative details of the work.

5.0 Safety Elements

5.1 Safety Representative

5.1.1 For all Projects, Contractors must designate a Safety Representative prior to the start of the Project. The Safety Representative must actively monitor safety issues on the job site on a daily basis and shall conduct comprehensive safety inspections on at least a weekly basis. The Safety Representative shall have at a minimum completed an

authorized 30-hour OSHA Construction Safety Course within the last five years of the start of the project and a current CPR/First Aid/AED training card. Upon written request by the Contractor, the University may grant an exemption to this requirement, on a case-by-case basis. The Contractor must request this exemption in writing to the University prior to the start of the project. For Projects with a construction or work volume of less than $30 million, this employee may also have additional site duties such as foreman, supervisor, or lead person.

5.1.2 For all Projects exceeding **$30 million** in total construction volume or deemed to be high risk by the Owner, Contractor must have a full-time Safety Professional assigned to the Project. For Projects involving a Construction Manager and exceeding $30 million in total construction volume, it shall be the Construction Manager's responsibility to supply a full-time Safety Professional. The duties of the full-time Safety Professional must be strictly limited to safety-related activities, with no additional job site duties. In addition to the qualifications stated for Safety Representative in the preceding paragraph, the Safety Professional must have one or more of the following credentials: a professional certification beyond those referenced in subparagraph 5.1.1, a college or professional degree related to safety & health, OSHA 500, or significant previous experience and skills necessary to thoroughly understand the health and safety hazards and controls relevant to the Project in question. The designation and adequacy of qualifications of the full-time Safety Professional shall be reviewed by the University, in writing, prior to commencement of the work.

5.2 Site Specific Safety Plan (SSSP):

Prior to starting the Work on any Project, all Contractors must complete and submit a SSSP that meets or exceeds the minimum requirements included in the University's Site Specific Safety Plan template. (See Appendix A). Contractors are encouraged to collaborate in the development of the SSSP with all the Project team members and other interested or affected members of the University Community.

The SSSP must be submitted to the designated University Representative on the Project (through the CORR process in e-Builder)**.** Please be sure to include provisions on how the University Community will be protected from any hazards associated with the Work. A Contractor may not begin work in the field until the SSSP has been submitted to the University. Contractors are encouraged to revise their SSSP during the Project in order to keep the plan relevant to the Work. The University reserves the right to add or remove additional requirements depending on the Project and its scope.

The University shall have the right, but not the obligation, to review and comment on the SSSP. The Contractor shall carefully consider any University comments regarding the SSSP, but the Contractor bears final responsibility for scope, detail, implementation,

enforcement, and administration of all such plans. Neither comments offered by the University nor the failure of the University to offer any comments shall in any way reduce the Contractor's responsibility for safety. Contractors' corporate safety program / manual shall be available for inspection by the University, upon request, but shall not be submitted in lieu of the SSSP.

5.3 Safety Inspections

5.3.1 Any of the inspections that are performed by a contractor shall be stored within the respective project folder within e-Builder.

5.3.2 *Daily Inspections*: The Contractor shall perform daily safety inspections on the job site. Any deficiencies shall be corrected as soon as possible or protected until corrections can be performed.

5.3.3 *Weekly Documentation:* On, at least, a weekly basis throughout the duration of the Project, the Contractor shall document its safety inspections for that week, per the following requirements:

- The weekly inspection report must describe any safety deficiencies and also identify a corrective action plan for any hazards identified in the report.
- The weekly inspection report shall be available for review by the University, upon request.
- In the event that a hazard cannot be immediately and completely remedied, the Contractor must provide a means of protecting all personnel from exposure to the hazard until it can be corrected or otherwise immediately cease work in the affected area or cease the activity causing the hazard.

5.3.4 Monthly Inspections*:* For projects exceeding $5 million in work volume or deemed to be high risk by the Owner, a principal for the Contractor, or the Contractor's designated senior overall safety officer shall inspect the job site on, at least, a monthly basis, and shall document all relevant findings, including safety concerns or deficiencies, accidents and incidents. The person performing this monthly inspection may not be an individual who is assigned to work on the job site on a daily or regular basis. Documentation of monthly inspections shall be available for review by the University, upon request.

5.3.5 University Project Visits: The Owner may perform random visits to Project sites to address adherence to the Site Specific Safety Program and the Contractor Safety Requirements:

- Any violations that are discovered will be reported to the responsible Contractor for prompt remediation and correction.
- Poor performance in regards to safety, as determined by the Owner, is grounds for contract termination and/or immediate removal from the Office of Physical Plant contractor prequalification listing.
- The Owner may also require meetings with contractors regarding safety on the Project.
- The Owner may request to review contractor safety inspection forms and the current SSSP, as required.

5.4 University General Site Safety Rules:

All Contractors are required to comply with all relevant Federal Occupational Safety and Health Regulations promulgated at 29 Code of Federal Regulations Part 1926 and Part 1910 at all times. These regulations provide the minimally acceptable work practices and procedures. The University also reserves the right to include additional requirements for a given Project based on industry best practices and the overall well-being of the University Community. Contractors must take steps to ensure the safety of faculty, staff, students, workers, and visitors of the University. Failure to comply with this document and/or the report of unsafe work shall be referred to the Owner. Incidents shall be reviewed on a case-by-case basis by Project Management & the Office of Physical Plant Safety Department. The following are PSU specific site rules of conduct that must be followed at all times by the contractor personnel on site:

- 100% head protection is required on the work site. (Head protection must be ANSI approved.)
- 100% eye protection is required on the work site. (Eye protection must be ANSI approved.)
- The premises shall be kept clean at all times and free from excessive dirt, rubbish, and debris resulting from the Project work. All rubbish and debris shall be removed from the work site each working day.
- Contractors shall report accidents and incidents, including Near Misses, immediately to the University Project representative, as further detailed at paragraph 5.6.19, below.
- No weapons, illegal drugs, ammunition, alcohol, or other illegal substances are permitted on the work site.
- Smoking is prohibited on the work site unless there is a designated area identified.

- At a minimum, all workers must wear long pants, t-shirts with sleeves at least 4" in length, appropriate footwear for the task being performed.

- ANSI approved high visibility vests, jackets, or t-shirts (min class 2) are required for anyone working near cranes, other heavy equipment and on/near roadways and traffic.

Note: These general site safety rules are considered the minimum acceptable rules for any job site; however, if a Contractor or CM's safety program or safety rules are more stringent, the more stringent rules shall apply.

5.5 Safety Data

The safety data listed below shall be provided to the University upon request during the course of the project. It must also be submitted with the final invoice or final application for payment submitted by the Contractor in order to be processed. These metrics need to be project specific. All numbers (hours, injuries/illnesses, inspections) for any subcontractor shall be included in your report. Metrics to be included in the monthly e-Builder CPA for the project.

- Cumulative hours worked
- Number of recordable injuries/illnesses[1]
- Number of lost time injuries/illnesses[1]
- OSHA Inspection information[1]

5.6 Specific Safety Requirements

5.6.1 **Crane Safety:** Prior to the operation of any crane on University property, a suitable location needs to be determined and the owner notified. Consideration should be made to the capacity of the physical site as well as any underground conditions. A PA One Call shall be made to confirm the presence and location of any utilities that may be located under the proposed site. See section 5.6.10 for additional information. All crane operators need to be certified by the National Commission for Certification of Crane Operators (NCCCO). All signal persons & riggers at a minimum need to be qualified in accordance with the OSHA standard. The University encourages contractors to have certified riggers & signal persons working on campus and reserves the right to request this depending on the scope of work being performed with a crane on PSU property. Contractors shall develop a lift plan for any crane work being performed. Any documentation must be provided to the owner upon request. Tag lines will be used on all lifts unless it is determined that the line itself will cause a greater hazard. If it is necessary to conduct a lift over an occupied building, a registered structural engineer

shall review and certify that the building can withstand the impact of the load being dropped on the building as a worst-case scenario. If the structural engineer determines that the building roof cannot withstand the impact, the building will need to be evacuated during the duration of the lift. The decision between evacuating the building or scheduling the lift for off-hours will be made by the University.

5.6.2 **Concrete & Masonry:** At no time should any contractor cut any concrete or masonry product without protecting themselves as well as others around them. This means that at a minimum, they should be using means to control the dust created from cutting of silica containing material. Dry sawing of concrete or other silica containing material is not permitted without having adequate controls in place. This includes any other activity that could create a potential silica exposure. Contractors are required to implement table 1 from 29 CFR 1926.1153 regarding Silica or have other controls in place, with validation of their effectiveness to ensure employee protection. The burden of proof will fall upon the contractor to prove to the owner their employees are complying with the OSHA standards regarding Silica containing material.

5.6.3 **Confined Spaces:** All contractors shall comply with 1926.1200, Subpart AA. In addition to this, the owner shall meet with the controlling contractor and complete the OPP Confined Space Communication & Coordination Form (Appendix C) if they will be working in or around a known permit required space. This form is designed to document all known Permit Required Confined Spaces within a project's work area. A contractor shall be responsible for providing their own rescue plan/services when working in a confined space when required. Contractors should also understand that their work and associated activities within a non-permitted space may change the classification of that space. Declassification of a permitted space must be completed by a competent person as described in the standard. See Owner for a listing of known PRCSs.

5.6.4 **Demolition, Structural:** Prior to any demolition taking place, an engineering survey shall be conducted by a Qualified Person. This survey should focus on the condition of the immediate work area as well as any adjacent structure(s) next to the demolition area. This survey should be used to create a plan for demolition. The contractor is also responsible for completion and submittal of notifications to PA DEP and US EPA. The plan should include provisions for encountering asbestos, lead, other hazardous material, dust and water control during the demolition phase. It should also include the proper disposal of demolition debris and any contaminated soil (if present). The contractor shall also ensure all utilities are controlled and in a safe condition prior to the start of demolition. Contractor shall also follow 5.6.10 to ensure that no utilities endangered during the scope/course of their work. This does not apply to demolition of a ceiling or other non-load bearing item (ceilings, some walls, and some other items).

5.6.5. Electricity: Any electricity used on a work site must be protected by either an assured grounding program or through the use of GFCIs. This includes electrical generators, welding machines, or existing building power supply. All cords will be of the heavy-duty type and have an intact ground prong and be in safe condition for use. Any electrical device shall be double insulated or grounded. No energized work will be performed on University property unless it conforms to OSHA and NFPA 70E. Notice shall be given to the University for approval of any energized work. For electrical shutdowns, refer to section 5.6.26.1.

5.6.6 Emergency Action Plan: All contractors shall have a plan in place to account for all workers on the site in the event of an emergency. This plan should also include an evacuation of the site to a safe location, accounting for employees and reasons for such an evacuation. This should be practiced and reviewed throughout the job. Contractors shall work with the Owner to coordinate these drills with their customers and PSU Police Services if necessary. Contact OPP Safety for more information.

5.6.7 Equipment Safety: The operator of any piece of mobile equipment/powered industrial truck, shall have been properly trained in the safe use of that equipment. This includes but is not limited fork lifts, all terrain fork lifts, scissor lifts, aerial lifts and other heavy equipment. The contractor shall also ensure the equipment is regularly inspected & maintained. Operators shall wear seatbelts at all times if equipped.

5.6.8 Fall Protection: All contractors must enforce 100% fall protection at 6' or higher (all trades). There may be a requirement to protect workers and employees when a hazard exists less than 6' below a lower level. The University would also discourage the use of a safety monitoring system for fall protection unless other means are determined to be infeasible or impossible.

5.6.9 Fire Prevention & Protection: Contractors shall follow The University's Hot Work Program while on the property. This includes supplemental fire protection for the duration of their hot work activity. At no time should a contractor rely upon any University owned fire protection equipment as their primary means. They should provide their own fire extinguisher(s) or other acceptable equipment. Contractors shall ensure that fire watch times are adhered to. If a contractor's Hot Work Program is more stringent than ours, they shall follow their own program. Additional information, including a copy of the PSU Hot Work Permit can be found here. (https://ehs.psu.edu/hot-work/requirements-guidelines)

5.6.10 Ground Disturbance & Penetration: Ground disturbance & penetration activities include but are not limited to driving stakes, removal or addition of plant life root systems, removal of sidewalk or roadway, removal of topsoil, removal of concrete bases, trenching, drilling, excavations, crane placement, blasting, etc. Contractors are required to submit and have a completed PA 1 Call prior to ANY ground disturbance or penetration regardless of method used, manual or mechanical. Contractors shall mark

their proposed area of work boundary in white paint with their company's initials or name and a number. This will differentiate projects when the contractor has more than one project on campus. These details must be described in the notes sections of the PA 1 Call. If a contractor uncovers an unmarked utility at any time during the course of their work, work shall stop immediately and notify their PSU representative and the Work Reception Center. Clearance to resume will only be given by the Safety Office. Contractors shall also inquire about the location of the high-pressure gas line that runs through parts of campus. Upon completion of the ground disturbance & penetration, the markings from the PA 1 Call shall be removed prior to leaving the site. If a contractor strikes, damages or impacts a utility of any kind at any time, they shall notify the owner (project manager, assistant project manager, head of maintenance (commonwealth campuses), or construction services representatives. Contractors shall submit a completed Appendix D prior to the start of any ground disturbance at least 24 hours prior to the disturbance of any material.

5.6.11 Hazard Communication/GHS: Contractors shall have in place a program that complies with OSHA 1910.1200 to train and instruct employees in the proper use and cleanup of any chemical or material on site. Safety Data sheets for any hazardous materials shall be on site and provided to the owner upon request. Compressed gases, fuel, and other hazardous materials shall be stored in accordance with applicable standards.

5.6.12 Hazardous Building Material: If a contractor's scope of work involves the abatement of any hazardous material, they shall first contact PSU Environmental Health & Safety to ensure compliance with University standards. Common materials abated on campus include asbestos, polychlorinated biphenyl (PCB) and lead paint. Additional information can be found on the PSU EHS website including policies and contact information. https://ehs.psu.edu/

5.6.13 Housekeeping: The contractor shall ensure that the job site and areas immediately outside of the work zone are kept clean daily for the duration of the Project. This includes proper storage of material, routes of egress, and areas leading outside the site. In order to keep up with housekeeping, contractors are encouraged to clean up and the end of every shift.

5.6.14 Indoor Air Quality: The contractor shall take steps to ensure that dust and other air contaminants are controlled when working in or nearby occupied spaces. This will require work barriers to be installed to separate the work zone from the occupied area of the building. This also means that substitution of products and materials and additional ventilation may be required. Air monitoring/testing may be required to ensure the safety of building occupants. If an IAQ problem is discovered, work will stop until the problem can be resolved. The specific requirements are set forth within the 01 50 00 Temporary Dust Barriers and Construction Indoor Air Quality Control Plan (https://oppwiki.atlassian.net/wiki/spaces/OPPDCS/overview)

5.6.15 Job Hazard Analysis/Activity Hazard Analysis: The contractor shall outline high frequency/high risk and low frequency/high risk activities using some type of analysis to identify, evaluate and control hazards. The analysis tool must list any measures that will be taken to mitigate any safety issues. This is a requirement of the Site Specific Safety Plan. Examples of high-risk work includes but is not limited to; crane picks, scaffolding, confined space, utility shut-downs, hazardous material abatement, hot work, trenching, etc.

5.6.16 Ladder safety: Contractors shall ensure that any ladder being used on their site has been inspected for damage prior to and during use. Any ladder that is identified as being damaged or defective shall be removed from use immediately. Ladders shall be used in accordance with the OSHA requirements for ladders.

5.6.17 OSHA Inspections: In the event that an OSHA inspector shows up on site, the contractor shall notify their PSU representative immediately and inform them of the purpose of their visit. If any violations are discovered, the contractor shall disclose those in a written report to the University as well as the corrective actions to be taken. Furthermore, the University's Project representative shall receive electronic copies of all correspondence or reports to or from OSHA. This information should be summarized in a contractor's final payment application or made available within e-Builder.

5.6.18 PPE: The contractor shall ensure that employees & visitors are wearing the minimum required PPE at all times. Additional PPE will be required when working with certain tools. Contractors shall consult manufactures instructions and OSHA standards for more information. Examples include fall protection equipment for fall exposures, face shields for demolition saws, and hearing protection. Refer to General Safety Rules section for additional PPE requirements.

5.6.19 Process Safety Management: Contractors working within a Process Safety Management (PSM) covered process area defined by the University shall abide by the additional qualification standards, training requirements, pre-project hazard assessments and enhanced on-site performance evaluations. Pre-project training provided by the University is required for all on-site contractor employees prior starting the project. In addition, strict compliance to the Management of Change and access to the covered process area will be enforced by site personnel. Additional information can be found on the Penn State EHS website including procedures and contact information. (https://ehs.psu.edu/process-safety-management/overview)

5.6.20 Record Keeping, Incident Reporting, & Major Accident Protocol: The contractor shall maintain records of safety training for their employees and shall document any

incidents that occur on the Project (including near misses). The contractor shall notify their University Representative immediately about any incident that occurs on the jobsite and submit a Safety Incident Report (SIR) via e-Builder within 24 hours). In the event that significant injury to a person (worker or other member of PSU community) or building damage has occurred, the contractor shall contact the University as soon as possible with initial details of the incident. The University will then initiate the appropriate accident protocols. The University reserves the right to hold a meeting with all responsible parties after an incident occurs to discuss its details, cause, and preventative measures contractors will implement going forward.

5.6.21 Scaffolding: All scaffolding must comply with OSHA's requirements. In addition, contractors shall implement some type of inspection system that will be maintained on the scaffold.

5.6.22 Sidewalk/Roadway work: When a contractor is working in or around a sidewalk or roadway, they shall take proper steps to ensure the safety of anyone in that area. This could mean the modification of a traffic pattern, a flag person(s), or a closure of that sidewalk and/or road. Adequate signage shall be posted and Hi-Vis clothing be worn. All work shall comply with Temporary Traffic Control Guidelines, Publication 213 (67 PA Code, Chapter 212). (See Appendix B, Jobsite Security Requirements).

5.6.23 Site Control/Site Security/Fencing: In order to maintain a safe jobsite, it is necessary for the contractor to isolate their work from any unauthorized persons. This could include fences, gates, temporary walls, or other means of protection. These should be inspected periodically to ensure the integrity of the control method. (See Appendix B, Jobsite Security Requirements, for additional site requirements & guidance)

5.6.24 Spill Prevention and Response

Contractors may have fuels, oils, and/or machinery which contains these materials on site, as well as other materials which may cause contamination if spilled or released. The Pennsylvania Department of Environmental Protection (PADEP) in 25 PA Code Chapter 102.5 (l) requires an operator to prepare and implement a Preparedness, Prevention, and Contingency (PPC) Plan when storing, using, or transporting several materials including: fuels, chemicals, solvents, pesticides, fertilizers, lime, petrochemicals, wastewater, wash water, core drilling wastewater, cement, sanitary wastes, solid wastes, or hazardous materials. If a contractor has a requirement from PADEP for a PPC Plan, it is the contractor's responsibility to prepare the PPC Plan that is specific to the type and volume of hazardous materials to be used/stored during the project. The PPC Plan provides information on the materials that could cause spills or releases, practices to reduce the possibility of these, and procedures that need to be undertaken if they occur.

Contractors have the primary responsibility for spill prevention, clean-up and for reporting spills to PADEP in accordance with 25 PA Code Chapter 91.33 and 91.34

regardless of the presence or absence of a PPC Plan. At Penn State, a contractor must contact PSU project management personnel as soon as possible following a release or spill of any of these materials. Contractors should have spill control materials on site that are sized to the largest expected release – typically these are hydraulic releases from equipment. Penn State provides the document Fuel Handling Practices, Spill Response, and Responsibilities for Contractors on the Environmental Health and Safety (EHS) website for guidance on spill/release cleanup. EHS may provide additional specific requirements based on the size of the spill, where the spill occurred, and the material spilled. They can also provide a few local environmental firm names that can assist with the required sampling for disposal and for confirming that cleanup has been complete, if needed. Spill cleanup reports are to be submitted to PSU site personnel and to EHS.

5.6.25 Trenching & Excavations: All excavations or trenching on campus shall comply with the applicable OSHA standards as well as section 5.6.10. The soil type on campus is typically treated as type C unless classified otherwise by a Qualified Person. A competent person must inspect the excavation prior to the start of work and after any event that could have compromised the safety of the trench or excavation. These records, along with methods & results of soil testing shall be available for the owner to review.

5.6.26 Utility Shutdown: During work, it may be necessary to shut down certain systems. These could include steam, electrical, sprinklers, and water. PSU has an established process shall be used and the shutdown shall be coordinated with the University prior to any utility being shut off. Contractors should go through their respective Owner points of contact (Project management staff, Construction Service Representatives etc.) (http://opp.psu.edu/about-opp/divisions/work-control-center/shutdown-coordination)

> **5.6.26.1 Electrical Shutdowns -** The Contractor shall be responsible for scheduling all electrical shutdown requests with the Office of Physical Plant. The Contractor shall be responsible for de-energization and energization of electrical equipment within Contractor's scope of work. The Office of Physical Plant will require a representative to be physically present during de-energization and energization of electrical equipment within the Contractors scope of work.

5.6.27 Utility Tunnels: Before working in a utility tunnel, the Contractor is responsible for coordination with the appropriate PSU Utility Contact. See Confined Space section at 5.6.3 for additional details. Contact Owner's representative for additional information.

5.6.28 Visitors/Tours: The University may bring visitors to the site for various reasons. These visits will be coordinated with the Contractor as far in advance as possible as to not impact the Project schedule. The Contractor shall hold these visitors to the same safety requirements as anyone else on the site. Orientation to the site may be required

depending on the scope of work at the time of the tour. The Contractor shall ensure that any recognizable hazards are controlled prior to visitors arriving on site. Site safety rules must be strictly adhered to at all times during the tour.

5.6.29 Weather: Contractors shall ensure that jobsites and any equipment or material stored on their jobsite is secured to prevent damage from severe weather. This includes the storage of equipment, materials or trash that may potentially fall from a height and/or cause personal injury or damage to property. This includes but is not limited to job site fences, building material, construction waste, temporary enclosures, lifts, and cranes.

Record of updates, changes & additions

Date of update	Location	Subject	Changed by	Notes
12/2017	5.6.24	Added spill section for contractors	JR/EHS	
12/2017	6.0	Added record of updates, changes & additions section	JR	
12/2017	Appendix B	Fencing requirements changed - blue screen and code reference	JR	
12/2017	Appendix E	Added Ground Disturbance Form	JR	
12/2018	5.3	Added e-Builder guidance for reporting	JR	
12/2018	5.5	Added e-Builder guidance for reporting	JR	New section
12/2018	5.6	Revised numbers for added sections to keep topics in alphabetical order	JR	New section
12/2018	5.6.2	Grammar edits	JR	
12/2018	5.6.17	Added e-Builder reference	JR	
12/2018	5.6.26.1	Add specifics on electrical shutdowns	JR	
12/2018	5.6.5	Added reference to electrical shutdown	JR	
4/2022	5.2/App. E	Added language regarding COVID 19	JR/JB	
2/2023	5.2/App. E.	Removed language regarding COVID 19	TJR	
5/2023	All/App. B	Grammar Corrections / Fencing requirement	TJR	

Appendix A

Site Specific Safety Plan (SSSP) Template

Purpose: The intent of this template is to identify the MINIMUM requirements of a Site Specific Safety Plan (SSSP) for any contractor awarded work at Penn State University (PSU). Contractors are encouraged to elaborate and expand upon these requirements.

SSSP Deliverable: The SSSP shall be submitted to the OPP Project representative along with other required contract documents prior to contract execution. Failure to submit the SSSP will result in a delay of the start of the Work. DO NOT SUBMIT your company's safety manual.

SSSP Template (minimum requirements): PSU reserves the right to request additional information on a project-by-project basis.

1. **Scope of Work**: narrative of the Project scope associated with your contract including schedule and major Project milestones.
2. **Designated On-Site Safety Representative and Competent Persons**
3. **Safety Orientation Program**: process to orient workers and visitors to your safety rules and expectations including ongoing toolbox safety talks.
4. **Hazard Communication Program and Safety Data Sheets**
5. **24-hour emergency points of contact**
6. **Site Logistics Plan**: plan shall address student/faculty/staff/public protection, traffic plan, equipment and lay-down areas, site security, tire washing, emergency evacuation muster points, etc.
7. **Min. PPE requirements**
8. **Accident Procedures**
9. **Safety Audit/Inspection Procedures**
10. **Project Clean-Up Plan:** detail how your company plans on keeping the workplace clean and free of potential hazards.
11. **Hazard Assessment:** identification of hazards associated with defined Project tasks. Please focus on highly hazardous tasks associated with the work (crane picks, scaffolding, confined space, utility shut-downs, hazardous material abatement, hot work, trenching, etc.).

Reminder: Contractors are required to submit the following information to PSU in each Contractor Pay Application via e-Builder:

1. Total Project man-hours worked
2. Total OSHA Recordable injuries and illnesses on Project[1]
3. Total Lost Time Injuries on Project[1]
4. OSHA Inspection information (if applicable) [1]

Any questions regarding the submission of SSSP may be directed to OPP Safety.

Appendix B

Construction Project Security/Fencing Requirements

The following safety and security measures shall be implemented on construction projects, as applicable. Contractors will work with their subcontractors and the University to ensure protection is in place for the safety of the University community. These requirements will cover project fencing, pedestrian overhead protection, construction traffic control measures, and construction signage. Contractors shall also monitor the effectiveness of these controls and ensure their integrity is maintained per the requirements and throughout the project. Public protection shall conform to all local codes in addition to the following requirements (the more stringent shall apply):

Project Fencing:

1. All construction projects (inclusive of stored material, equipment, etc.) shall be fenced at all open perimeters to prevent unauthorized or inadvertent entry by the public.

2. Provide a six-foot high (6') chain-link fence with galvanized frame and entry gates as required. All fencing includes top and bottom stabilizing rail between posts. All fence tubing shall be capped at an open end.

3. Provide 5'–6" continuous mesh fabric windscreen, mount top of fabric to top stabilizing bar. Fabric shall be PVC vinyl coated polyester, equal to Tenn-air curtain style, color US Open blue as manufactured by M. Putterman and Co., Inc. (800) 621-0146. Windscreen shall have reinforced hems and grommets every 12 inches on all edges. Install windscreen on construction side of fence, using 50-pound break strength tie wraps at every grommet. Pull fabric taught and maintain in this condition.

4. The Contractor is responsible for ensuring the fencing is designed and installed according to the currently adopted versions of the applicable building code(s). Gaps in fencing shall not exceed 4" in the vertical or horizontal direction at any location.

5. Where construction material may tend to splash or fly into public areas, the fence shall be constructed of solid material such as plywood and be free of openings which might permit the passage of the materials. This fence should also meet the same requirements stated within this document.

6. Fences shall be free of projections such as protruding nails, etc., upon which the public may become injured. Additionally, when pedestal fencing bases are used (meeting the performance requirements of this document) shall not protrude more than 5 inches into a walking path. In general, fences shall be free of projections that may present tripping hazards to the public.

7. No materials, debris, or equipment shall be stored outside of the fencing.

8. Openings in fences for the passage of construction vehicles and employees shall be equipped with gates that in a closed condition do not allow unauthorized or inadvertent entry by the public. All gates shall remain in a closed condition when not in use.

9. All gates shall be equipped with locking devices and shall be locked during non-working hours.

10. Where the erection of fences is not immediately feasible due to the nature of the work, or where fences must be temporarily taken down to facilitate the work, alternative protection shall be provided to ensure the safety of the public.

11. Gates should swing inward as to not create a hazard to oncoming pedestrian and vehicular traffic.

12. All fences shall be installed in a manner to allow access to building fire department connections (FDCs).

13. Variants to any of the previous details must be submitted and approved by the assigned PSU project team.

Pedestrian Overhead Canopies:

1. When applicable or necessary, sidewalk canopies or covered walkways erected over pedestrian walkways shall be constructed according to local codes. Overhead protection must be built in a manner to prevent falling objects, tools and/or debris from harming the public. Roof canopy protection shall be designed and installed to withstand projected impact loading from overhead work.

2. Temporary walkways constructed under canopies shall present a smooth and stable walking surface, free of excessive deflection and tripping hazards, comply with ADA requirements.

3. Canopies and covered walkways shall be lit in accordance with local codes. Maintain lighting in working order at all times.

4. Canopy roofs are not to be used for the storage of construction materials or equipment.

5. Canopies are not to be used as work platforms.

Construction Traffic Controls:

1. Each Contractor shall assign dedicated personnel to direct construction delivery traffic to ensure pedestrian safety. All construction operations involving workers, construction vehicles, and equipment in the public way, which are not static or fixed, but are changing or

fluid, shall be attended by one or more flaggers as required to safely control pedestrians and other vehicular traffic around the operations.

2. Traffic control personnel shall be trained in accordance with PennDOT Publication 213. In all cases where flaggers are used to control pedestrians and vehicular traffic, they shall receive instructions on the type of work to be done, traffic controls required, and proper signaling of traffic.

3. Construction vehicles backing up on the job site shall be equipped with back-up alarms or have a flagger.

4. Flaggers shall wear high visibility PPE, ANSI approved, and use a flag to signal traffic.

5. Where construction operations take place in a pedestrian walkway or create safety hazards over pedestrian walkways, the walkway shall be closed and pedestrian traffic routed to safe, alternate walkways. Walkways shall be closed with barricades and warning signs clearly posted at the points of closure, warning of the hazard and clearly indicating the alternate walkway.

Construction Signage:

1. Subcontractor shall provide for the prompt and conspicuous posting and maintenance of Danger Signs, Caution Signs and Safety Instruction Signs as required for general use at the project to alert and inform subcontractors and workers of safety hazards and safety rules and regulations.

2. Areas adjacent to gates where construction vehicles are entering and leaving the job site shall be posted with signs warning the public to watch out for trucks and other vehicles.

3. All doors, gates or other points of entry from occupied areas into construction areas shall be posted with warning signs. Signs may state “DANGER: CONSTRUCTION AREA,” “KEEP OUT,” “AUTHORIZED PERSONNEL ONLY,” etc. Signage strategy must be reviewed with the University.

4. Where blind spots may exist for pedestrians or motorists along fences, under canopies, at approaches to driveways or gates where construction vehicles are entering or leaving the job site, appropriate warning signs shall be posted to warn the public of the hazard. Strategic placement of Plexiglas mirrors will help both pedestrians and vehicles through potential blind spots.

5. Contractors shall post sings with jobsite information regarding emergency contact information for the project.

6. Contractors shall provide signs on fencing that identifies the locations of any fire hydrant, FDC, or other important location so it can be seen from the road/street.

Appendix C

OPP Confined Space Communication & Coordination Form

To comply with 29 CFR 1926.1203(h), an owner's representative (Project Management, Construction Services Representative, Commonwealth Services, OPP Safety, or EHS) shall review the following information with a contractor regarding permit required confined spaces, PCRS, at the project mentioned below. If contractor's scope does not include entry into a PRCS, the owner will ensure that any PRCS in which a contractor could enter is properly identified and secured.

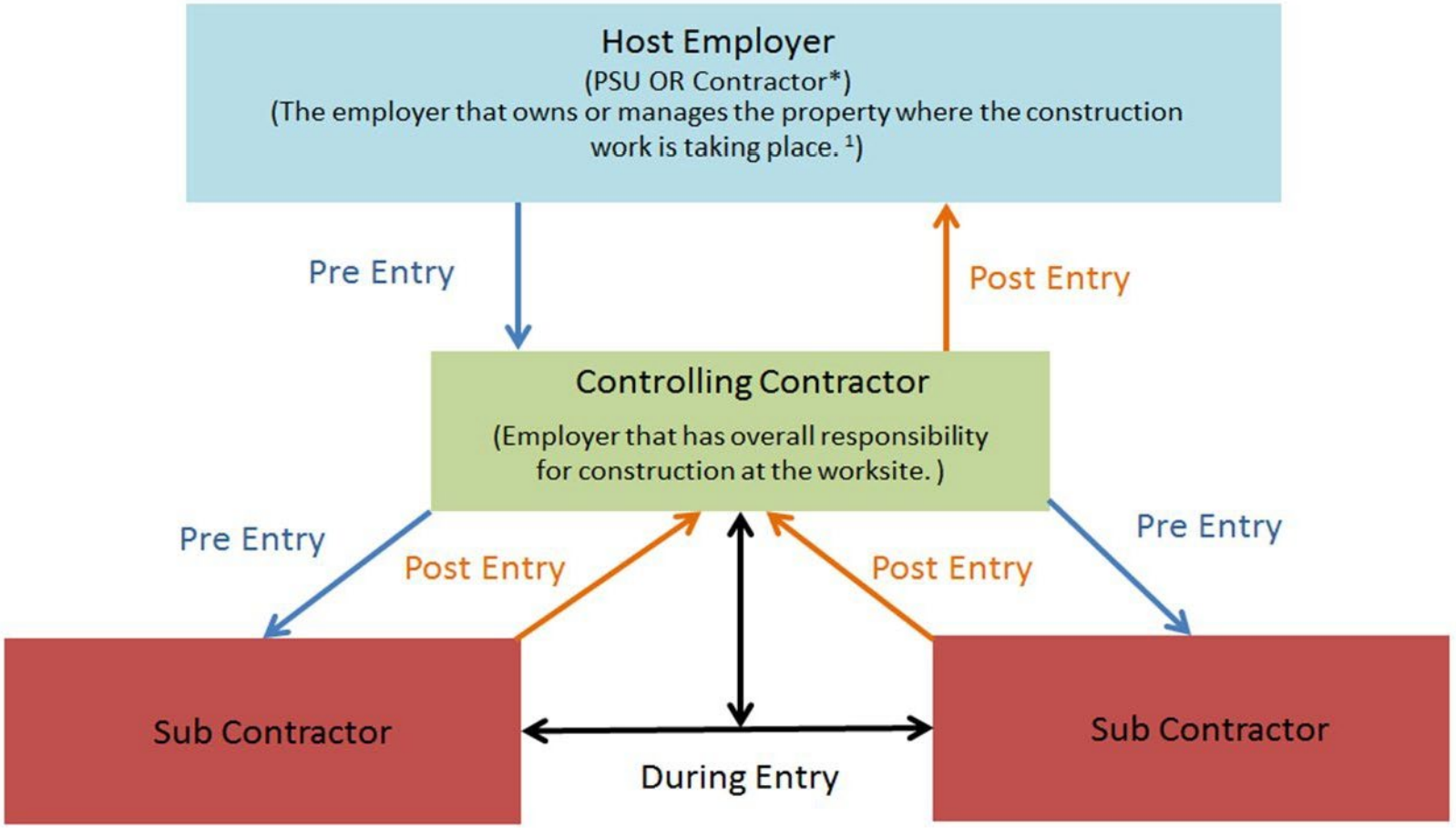
Date		**Project Name**	
Project Number		**Campus (UP, Berks, Erie)**	
Owner's Representative (Name & Title)		**Contractor's Representative (Name & Company)**	

Before entry into any PRCS takes place, the owner shall meet with the contractor assuming control of the project or PRCS to discuss the following regarding each PRCS associated with that project (Location of PRCS, hazards of each PRCS, precautions that previous contractors or hosts have used in each PRCS, any other information related to the PRCS).

Location of PRCS	**Hazards of PRCS**	**Precautions**	**Additional Information**

Once completed, work can then begin according to the appropriate confined space standard (29 CFR 1910. 146 and/or 1926.1200) and the contractor's confined space program.

PSU Confined Space Flow Chart



1. If the owner of the property on which the construction activity occurs has contracted with an entity for the general management of that property, and has transferred to that entity the information specified in §1203(h)(1), OSHA will treat the contracted management entity as the host employer for as long as that entity manages the property. Otherwise, OSHA will treat the owner of the property as the host employer. In no case will there be more than one host employer. Please use the reverse side of this form to document this meeting.

PennState Physical Plant

Office of Physical Plant
Physical Plant Building
University Park, PA 16802-1118

Appendix D - Office of Physical Plant Ground Disturbance Form

This form is to be completed in its in entirety by the person in charge of the ground disturbance (digging, excavation, stake driving etc.) This form shall be submitted electronically to the PSU Project Manager/Leader, CSR (if assigned), the Maintenance Supervisor (Commonwealth Campuses) and oppsafety@psu.edu at least 1 business day prior to any earth disturbance. If the scope changes to include a larger area, this form will need re-accomplished along with another PA 1-Call. Pictures of the site post 1 Call may be included with the form.

Project Name		
Project Number/Work Order Number		
Project/Work Order Start & End Dates of ground disturbance		
Location of disturbance (marked in white with company initials & #)		
PA 1-Call Ticket Number/Date		
Ground Disturbance Activities on Site ☐ Driving of any stake ☐ Add/remove plant life root systems ☐ Trenching/excavation ☐ Sidewalk/roadway removal ☐ Crane placement ☐ Blasting ☐ Topsoil removal ☐ Other	Utilities that were located on site ☐ Temp. Survey Markings (pink) ☐ Electrical (Red) ☐ Gas, oil, steam, petroleum or gaseous material (yellow) ☐ Communication, alarm, or signal line (orange) ☐ Potable water (blue) ☐ Reclaimed water, irrigation, and slurry (purple) ☐ Sewer and drain lines (green) ☐ Other: (color:)	
Other resources consulted – list (drawings, mapping etc.)		
Contractor Name, 24-hour POC and Contact info, include email & phone number		
PSU Project Manager/Leader Name (Contact info, include		
PSU Construction Services Rep/Maintenance Supervisor (Contact info, if assigned)		
Name & Contact of person completing permit (Printed)		

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Waste Management

DOCUMENT NUMBER: 258-2182-773

EFFECTIVE DATE: January 16, 2021

TITLE: Management of Fill Policy

AUTHORITY: This document is established in accordance with the Solid Waste Management Act, 35 P.S. §§ 6018.101 *et seq.* (SWMA); the Clean Streams Law, 35 P.S. §§ 691.1 *et seq.*; Section 1917-A of the Administrative Code, 71 P.S. § 510-17; and the Land Recycling and Environmental Remediation Standards Act, 35 P.S. §§ 6026.101 *et seq.*

POLICY: A person placing solid waste onto the ground is generally required to obtain a disposal permit from the Department of Environmental Protection (Department or DEP). A person is not required to obtain a permit under SWMA if the person can demonstrate that the material qualifies as clean fill in accordance with the municipal and residual waste regulations, 25 Pa. Code § 271.101(b)(3) and § 287.101(b)(6).

PURPOSE: This policy provides DEP's procedures for determining whether fill is "clean fill," as defined in the municipal and residual waste regulations at 25 Pa. Code § 271.1 and § 287.1, respectively, or "regulated fill," as defined in this policy. Regulated fill may not be used outside of a project area or right-of-way of a project unless a SWMA permit has been issued to the person using the regulated fill.

APPLICABILITY: This policy shall be used to evaluate whether a person is required to obtain a permit under the SWMA for the use of fill in accordance with the municipal and residual waste regulations, 25 Pa. Code § 271.101(b)(3) and § 287.101(b)(6). This policy describes the type of fill that qualifies as clean fill or regulated fill. This policy does not apply to mine land reclamation activities subject to a permit or fill used within the same project area or project right-of-way. Excavation, movement or reuse of fill within a project area or right-of-way of a project is not an activity that requires a SWMA permit. This policy does not apply to fill that has been determined to be clean or regulated fill prior to the effective date of this policy, unless the fill is moved to a new receiving site or off the project area or project right-of-way after the effective date of this policy. This policy does not apply to fill that has been determined to be clean or regulated fill prior to the implementation of revised clean fill concentration limits or regulated fill concentration limits, unless the fill is moved to a new receiving site or off the project area or project right-of-way after the effective date of the revised limits.

DISCLAIMER: The policies and procedures outlined in this guidance document are intended to supplement existing requirements. Nothing in the policies or

procedures shall affect regulatory requirements. The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of the DEP to give the rules in these policies that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

PAGE LENGTH: 26 pages

DEFINITIONS:

Acid-producing rock – Stone, rock or other mineral materials that, when exposed to air and water, cause a low pH discharge that adversely affects or endangers public health, safety, welfare, or the environment or causes a public nuisance.

Act 2 – The Land Recycling and Environmental Remediation Standards Act, 35 P.S. §§ 6026.101 *et seq.*

Act 2 site – A site as defined in Section 103 of Act 2, 35 P.S. § 6026.103, for which a notice of intent to remediate has been submitted to DEP.

Background – The concentration of a regulated substance that is present at a site but not related to the release of regulated substances from a specific point source or activity at the site.

Background reference area – The area identified for sampling that: will be used to establish background; is sampled and analyzed to determine the concentration of regulated substances found at or within a close proximity to the donor site, at a depth comparable to that of the area to be excavated at the donor site, in the same soil layer as the donor fill; is unaffected by a release of regulated substances from a specific point source or activity at the site; and meets one of the following criteria:

i. The concentration of regulated substances in the soil is attributable to the parent material from which the soil was derived and the natural processes which produce soil, or

ii. The concentrations of regulated substances in the soil resulted from an atmospheric deposition, including lead or polynuclear aromatic hydrocarbons, but are not attributable to a specific point source or release of a regulated substance. For the purposes of this definition, "atmospheric deposition" refers only to the ubiquitous, widespread deposition of regulated substances from the air that is incapable of being traced to a specific point source or multiple point sources. For example, chromium that has condensed on the ground outside an electroplater air vent would not be due to "atmospheric deposition" because the presence of the chromium is a result of a discharge from a specific point source, even though the chromium was released into the air before being deposited on the ground. However, the presence of lead or benzo-a-pyrene (BAP) in an urban or industrial area that can be traced to the operation of motor vehicles may be due to atmospheric deposition if the concentration levels are demonstrated to be pervasive over the greater urban or industrial area.

Clean fill – Uncontaminated, nonwater-soluble, nondecomposable, inert solid material used to level an area or bring an area to grade. The term does not include materials placed in or on the waters of the Commonwealth. Although the placement of clean fill in or on waters of the Commonwealth cannot be managed under this policy, placement of clean fill in or on waters of the Commonwealth may be approved under a separate DEP authorization. The term includes only those materials that are identified as "fill," as the term is defined in this policy. The term does not include fill that has been blended, mixed or treated with the purpose of meeting the definition of "clean fill" and that without being blended, mixed or treated would fail to meet the numeric limits identified in the definition of "uncontaminated material" contained in this policy.

Clean fill concentration limits (CFCLs) – With the exception of PCBs and chloride, the concentrations of regulated substances that do not exceed the numeric values specified in Table 3 [Medium-Specific Concentrations (MSCs) for Organic Regulated Substances in Soil] and Table 4 [Medium-Specific Concentrations (MSCs) for Inorganic Regulated Substances in Soil] of Appendix A in 25 Pa. Code

Chapter 250 (relating to administration of land recycling program). The applicable numeric limit is determined by comparison of the Generic Soil to Groundwater Value[1] with the Direct Contact Residential Value[2] and selection of the lower of the two values. For PCBs, the sum total of the concentration of all PCB aroclors (total PCB concentration) may not exceed 50 ppm. Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. Section 2601 et seq., and 40 C.F.R. Part 761, which is administered and implemented by the U.S. Environmental Protection Agency (EPA). EPA's TSCA requirements are independent of any use of fill that is otherwise in accordance with the Department's policy and regulations. An applicant should be aware that its characterization and handling of any soils through the guidance of the Management of Fill policy does not necessarily satisfy a potential EPA TSCA inquiry, and that an applicant may need a separate approval from EPA should EPA require it. For all such material, DEP recommends that you contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine whether PCB-containing fill may be used and to obtain information relating to the associated EPA procedures for collecting and analyzing samples. For chloride, the value obtained using the Synthetic Precipitation Leaching Procedure, (SPLP, SW-846, Method 1312) may not exceed the numeric value specified in Table 2 [MSCs for Inorganic Regulated Substances in Groundwater] of Appendix A in 25 Pa. Code, Chapter 250.

Composite sample – A sample collected across a spatial range that typically consists of a set of discrete samples that are combined or "composited." A composite sample should not be confused with a discrete sample that is created from multiple increments taken at a single location to obtain a sample of the desired size, shape and orientation.

Discrete sample – A sample that represents material from a single location. A discrete sample can be composed of more than one increment.

Donor site – The area from which fill originates that is separate from a receiving site. Multiple donor sites may be identified on a single project area.

Environmental due diligence – Investigative techniques used to determine whether fill from a donor site has been affected by a release of a regulated substance. Examples of investigative techniques included in this term are visual property inspections, electronic data base searches, review of ownership and historical use of a property, Sanborn maps, environmental questionnaires, transaction screens, analytical testing, environmental assessments, audits, or procedures outlined in ASTM standard E1527-13. A single investigative technique may not be used as the basis for environmental due diligence. Environmental due diligence includes visual property inspection and a review of ownership and historical property use, at a minimum, unless analytical sampling is performed in lieu of a review of ownership and historical property use.

Fill – The term is limited to clean, regulated and historic fill that is soil, rock, stone, gravel, used asphalt, brick, block or concrete from construction and demolition activities that is separate from other waste and recognizable as such, and "dredged material," as the term is defined by the municipal and residual waste regulations, 25 Pa. Code §§ 271.1 and 287.1, whichever is applicable. The term does not include reclaimed asphalt pavement, naturally occurring asbestos, mine spoils or acid-producing rock.

Grab sample – A discrete sample, consisting of one increment, collected specifically for Volatile Organic Compounds (VOC) analysis.

[1] Numeric values based on generic leaching modeling for soils at residential properties overlying used aquifers with total dissolved solids at concentrations less than or equal to 2500 mg/L.
[2] Direct contact numeric values for soils at residential properties.

Historic fill – Material, excluding material disposed in landfills, waste piles and impoundments, used to bring an area to grade prior to 1988, and consisting of a conglomeration of soil and residuals, such as ashes from the residential burning of wood and coal, incinerator ash, coal ash, slag, dredged material and construction and demolition waste. The term does not include iron or steel slag that is separate from residuals if it is a coproduct, as the term is defined in 25 Pa. Code § 287.1 and satisfies the requirements of 25 Pa. Code § 287.8. The term does not include coal ash that is separate from residuals if it is beneficially used in accordance with 25 Pa. Code §§ 290.1 – 290.415.

Increment – Material collected in a single operation of the sampling device.

PCB – A chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or a substance that contains that substance.

ppm – Parts per million.

Project area – The boundary within which earth disturbance activities occur, including areas in close proximity to the earthmoving activities that are necessary for the completion of a construction project, or other human activity which disturbs the surface of the land, including land clearing and grubbing; grading; excavations; embankments; land development; agricultural plowing or tilling; operation of animal heavy use areas; timber harvesting activities; road maintenance activities; linear projects such as utility line work; oil and gas activities; well drilling; mineral extraction; and the moving, depositing, stockpiling, or storing of soil, rock or earth materials. The term includes the boundary within which all earth disturbance activity, construction, materials storage, grading, landscaping and related activities occur.

Reclaimed asphalt pavement (RAP) – Small particles, typically less than one inch in size, of bitumen and inorganic materials produced by the mechanical grinding of bituminous pavement surfaces that have not been subject to a release of regulated substances or mixed with other solid waste. The term does not include "used asphalt," as the term is defined in this policy.

Receiving site – The area to which fill is proposed to be relocated. A receiving site is separate from a donor site and not part of a project area or right-of-way.

Regulated fill – "Fill," as the term is defined in this policy, that has been affected by release of a regulated substance and is not "uncontaminated material," as the term is defined in this policy. The term does not include fill that has been blended, mixed or treated with the purpose of meeting the definition of "regulated fill" and that without being blended, mixed or treated would fail to meet the regulated fill concentration limits, as the term is defined in this policy.

Regulated fill concentration limits (RFCLs) – With the exception of PCBs, the concentrations of regulated substances that do not exceed the numeric values specified in Table 3 [Medium-Specific Concentrations (MSCs) for Organic Regulated Substances in Soil] and Table 4 [Medium-Specific Concentrations (MSCs) for Inorganic Regulated Substances in Soil] of Appendix A in 25 Pa. Code Chapter 250 (relating to administration of land recycling program). The applicable numeric limit is determined by comparison of the Generic Soil to Groundwater Value[3] with the Direct Contact Non-Residential Value[4] and selection of the lower of the two values. For PCBs, the sum total of the

[3] Numeric values based on generic leaching modeling for soils at non-residential properties overlying used aquifers with total dissolved solids at concentrations less than or equal to 2500 mg/L.
[4] Direct contact numeric values for soils at non-residential properties.

concentration of all PCB aroclors (total PCB concentration) may not exceed 50 ppm. Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. Section 2601 et seq., and 40 C.F.R. Part 761, which is administered and implemented by the EPA. EPA's TSCA requirements are independent of any use of fill that is otherwise in accordance with the Department's policy and regulations. An applicant should be aware that its characterization and handling of any soils through the guidance of the Management of Fill policy does not necessarily satisfy a potential EPA TSCA inquiry, and that an applicant may need a separate approval from EPA should EPA require it. For all such material, DEP recommends that you contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine whether PCB-containing fill may be used and to obtain information relating to the associated EPA procedures for collecting and analyzing samples.

Regulated substance – The term includes hazardous substances and contaminants regulated under the Hazardous Sites Cleanup Act, 35 P.S. §§ 6020.101 *et seq.*; and substances regulated by the Clean Streams Law, 35 P.S. §§ 691.1 *et seq.*; the Air Pollution Control Act, 35 P.S. §§ 4001 *et seq.*; the Solid Waste Management Act, 35 P.S. §§ 6018.101 *et seq.*; the Infectious and Chemotherapeutic Waste Law, 35 P.S. §§ 6019.1 *et seq.*; and the Storage Tank and Spill Prevention Act, 35 P.S. §§ 6021.101 *et seq.*

Release – Spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing of a regulated substance into the environment in a manner not authorized by the Department. The term includes the abandonment or discarding of barrels, containers, vessels and other receptacles containing a regulated substance.

Uncontaminated or *Uncontaminated material* – The term means either of the following:

(1) Fill unaffected by a release of a regulated substance or,

(2) Fill affected by release of a regulated substance, if the concentrations of regulated substances in the fill do not exceed the clean fill concentration limits, as the term is defined in this policy. Analysis should be carried out for only those regulated substances that are suspected to be present due to a release.

The term does not include fill that has been blended, mixed or treated with the purpose of meeting the definition of "uncontaminated material."

Used asphalt **–** Pieces of bitumen and inorganic materials from the demolition of bituminous pavement. The term does not include "reclaimed asphalt pavement," as the term is defined by this policy.

REFERENCES:

25 Pa. Code Chapters 287 to 299 (residual waste regulations)
25 Pa. Code Chapters 271 to 285 (municipal waste regulations)
Solid Waste Management Act, 35 P.S. §§ 6018.101 *et seq.*
Land Recycling and Environmental Remediation Standards Act, 35 P.S. §§ 6026.101 *et seq.*
Section 1917-A of the Administrative Code, 71 P.S. § 510-17
The Clean Streams Law, 35 P.S. §§ 691.1 *et seq.*

TECHNICAL GUIDANCE:

A. Purpose and Applicability

Fill is used in construction or earthmoving projects across the Commonwealth to level an area or bring an area to grade. These projects may involve using fill as a subbase or to fill in low-lying areas. The manner in which fill may be used depends on whether the fill is clean fill or regulated fill. This policy provides procedures for determining whether fill is clean fill or regulated fill and describes how each category may be managed after a fill determination has been performed.

This policy does not apply to the following activities:

- Mine land reclamation activities subject to a permit.
- Management of waste from land clearing, grubbing and excavation, including trees, brush, stumps and vegetative material.[5]
- Movement or use of fill within a project area or right-of-way of a project.
- Use of reclaimed asphalt pavement in accordance with DEP's industry-wide coproduct determination.
- The use of clean fill or regulated fill prior to January 1, 2020, unless the fill is moved to another receiving site, project area or off the project right-of-way after January 1, 2020.

In general, fill that is demonstrated to be clean fill can be used in an unrestricted manner, provided it is not placed in waters of the Commonwealth; it is used in compliance with 25 Pa. Code, Chapters 102 and 105 (relating to erosion and sediment control; and dam safety and waterway management); and it is managed in accordance with Section D of this policy. Persons using fill must also comply with the fugitive emissions regulations under 25 Pa. Code, Chapter 123 (relating to standards for contaminants) issued under the Air Pollution Control Act, 35 P.S. § 4001, and shall comply with all the applicable provisions of 25 Pa. Code §§ 123.1 and 123.2 (relating to prohibition of certain fugitive emissions and fugitive particulate matter). Depending on the manner in which it is generated, clean fill may be a "waste," as that term is defined in the municipal or residual waste regulations, 25 Pa. Code § 271.1 and § 287.1, respectively, whichever is applicable.

This policy does not apply to fill that has been determined to be clean or regulated fill prior to the implementation of revised CFCLs or RFCLs, unless the fill is moved to a new receiving site or off the project area or project right-of-way after the effective date of the revised CFCLs or RFCLs.

Fill that is demonstrated to be regulated fill can be used by persons who have applied for and obtained coverage under the Department's General Permit No. WMGR096, Beneficial Use of

[5] In accordance with 25 Pa. Code § 271.101(b)(4), a person managing waste from land clearing, grubbing and excavation, including trees, brush, stumps and vegetative material, shall implement best management practices developed by the Department. Refer to Document No. 254-5400-001 - *Best Management Practices for the Management of Waste From Land Clearing, Grubbing, and Excavation (LCGE)*.

Regulated Fill. Coverage under General Permit No. WMGR096 is not required in the following instances:

- Remediation activities undertaken entirely on an Act 2 site, pursuant to the requirements of § 902 of Act 2.

- When fill from an Act 2 site is used as construction material at a receiving site that is being remediated to attain an Act 2 standard, provided the procedural and substantive requirements of Act 2 and the conditions specified in Section C.2.a. and b. of this policy are satisfied.

- Use of the regulated fill is limited to the excavation, movement or use of the regulated fill within a project area or right-of-way of a project.

Regulated fill is a "waste," as that term is defined in the municipal or residual waste regulations, 25 Pa. Code § 271.1 and § 287.1, respectively.

B. Procedure for Performing a Fill Determination

Prior to the movement of fill to a receiving site, either the person proposing to provide the fill from a donor site or the person proposing to receive the fill determines whether the fill is clean fill or regulated fill pursuant to this policy. Use the following steps to make that determination:

1. Determine Eligibility: A material is eligible for management as clean or regulated fill under this policy if it satisfies the following criteria:

    a. The material is "fill," as the term is defined in this policy. If the fill under consideration contains acid-producing rock, it is specifically excluded from the definition of fill. Appendix B contains information relevant to identifying acid-producing rock.

    b. The fill does not contain regulated substances that were intentionally released.

    c. The fill has not been blended, mixed or treated with the purpose of meeting the definition, or applicable numeric limits, of "uncontaminated material," "clean fill" or "regulated fill."

    d. The fill does not exhibit a characteristic of toxicity, as determined by 40 CFR § 261.24 (relating to toxicity characteristic). The toxicity characteristic is of concern only when environmental due diligence indicates that the fill being considered for use may have been affected by a release of a regulated substance that is included in Table 1 in 40 CFR § 261.24. If the total concentration of the substance exceeds the limit for the substance in Table 1 of 40 CFR § 261.24 by a factor of 20 or more, the issue regarding potential toxicity should be addressed either by performing the Toxic Characteristic Leaching Procedure (TCLP), in accordance with Method 1311, found in the most recent version of EPA's publication, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, also known as SW–846, or providing additional description of the fill, indicating that the substance is bound in the matrix and not leaching.

e. PCB-containing Fill: If the environmental due diligence indicates that the fill may have been subject to a release of PCBs, test it for the presence of PCBs. Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601 *et seq.*, and 40 CFR Part 761, which is administered and implemented by the EPA. EPA's TSCA requirements are independent of any use of fill that is otherwise in accordance with the Department's policy and regulations. An applicant should be aware that its characterization and handling of any soils through the guidance of the Management of Fill policy does not necessarily satisfy a potential EPA TSCA inquiry, and that an applicant may need a separate approval from EPA should EPA require it. For all such material, DEP recommends that you contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine whether PCB-containing fill may be used and to obtain information relating to the associated EPA procedures for collecting and analyzing samples.

2. Perform Environmental Due Diligence: Once determined that the fill is eligible for use under this policy, evaluate the fill to determine whether it has been affected by a release of a regulated substance by performing "environmental due diligence," as the term is defined in this policy. Except for historic fill, analytical testing of the fill is not necessary unless environmental due diligence indicates that the fill may have been affected by a release of a regulated substance. However, a person performing a fill determination may choose to perform analytical testing in lieu of conducting a review of ownership and historic property use to satisfy the minimum condition for performing environmental due diligence.

The use of historic fill as clean fill under this policy is limited to historic fill that is a conglomeration of soil, residuals and fill. Historic fill that is comprised primarily of residuals does not represent a conglomeration of soil, residuals, and fill and therefore, cannot be used as clean fill. Pockets of residuals, such as ash or slag, should be removed and managed separately from other historic fill prior to making a determination that the historic fill can be used as clean fill. Perform analytical testing to demonstrate that the historic fill meets the definition of uncontaminated material. To qualify for use as clean fill, historic fill should be tested for the parameters included in Table 1, below, as well as any additional parameters that are suspected based on historic property use or review of records. The placement of historic fill as clean fill may not contaminate groundwater. For regulated substances detected in the historic fill, the value obtained using the Synthetic Precipitation Leaching Procedure, (SPLP, SW-846, Method 1312) may not exceed the numeric value as identified in Table 1 [MSCs for Organic Regulated Substances in Groundwater] and Table 2 [MSCs for Inorganic Regulated Substances in Groundwater] of Appendix A in 25 Pa. Code, Chapter 250.

a. If due diligence shows no evidence that the fill may have been affected by a release of a regulated substance, the fill may be managed as clean fill in accordance with the Section D of this policy (relating to management of clean fill) unless during movement, transport or placement there are observable indications (such as appearance or odors) which indicate evidence of a release of a regulated substance.

b. If due diligence shows evidence that the fill may have been affected by a release of a regulated substance, test the fill to determine if it is clean fill or regulated fill. Perform the testing in accordance with Appendix A of this policy. Analysis should be carried out for only those regulated substances that are suspected to be present due to a release or based upon historic use of the donor site.

i. Except as provided elsewhere in this policy, if testing reveals that the fill contains regulated substances at concentrations that are below the CFCLs, the fill may be managed as clean fill in accordance with Section D of this policy (relating to management of clean fill). A person may not blend, mix or treat fill that would otherwise fail to meet the CFCLs with the purpose of meeting the definition of uncontaminated material or clean fill. For the purposes of completing Form FP-001 for the certification of clean fill, the CFCLs in effect on the date of submission should be used to evaluate whether the fill qualifies for use as clean fill.

ii. Except as provided elsewhere in this policy, if testing reveals that the fill contains regulated substances at concentrations that exceed the CFCLs but are at or below the RFCLs, the fill may be managed as regulated fill only if coverage under General Permit No. WMGR096 is obtained. A person may not blend, mix or treat fill that would otherwise fail to meet the RFCLs with the purpose of meeting the definition of regulated fill. Manage regulated fill in accordance with the Section C of this policy (relating to management of regulated fill).

iii. Except as provided elsewhere in this policy, if testing reveals that the fill contains regulated substances at concentrations that exceed the RFCLs, the fill may not be managed as clean fill or regulated fill. Fill exceeding the RFCLs may require disposal in accordance with the hazardous, municipal or residual waste regulations, 25 Pa. Code, Articles VII, VIII or IX, respectively, whichever is applicable.

TABLE 1: Screening Parameters for Historic Fill

Regulated Substance	CASRN	Regulated Substance	CASRN	Regulated Substance	CASRN
Aldrin	309-00-2	PCB-1254 (Aroclor)	11097-69-1	Copper	7440-50-8
Anthracene	120-12-7	Phenanthrene	85-01-8	Iron	7439-89-6
Benzene	71-43-2	Pyrene	129-00-0	Lead	7439-92-1
Benzo(a)anthracene	56-55-3	Toluene	108-88-3	Manganese	7439-96-5
Benzo(a)pyrene	50-32-8	Trichloroethane, 1,1,1-	71-55-6	Mercury	7439-97-6
Benzo(b)fluoranthene	205-99-2	Trichloroethylene (TCE)	79-01-6	Molybdenum	7439-98-7
Benzo(ghi)perylene	191-24-2	Xylenes (Total)	1330-20-7	Nickel	7440-02-0
Chrysene	218-01-9	Aluminum	7429-90-5	Selenium	7782-49-2
Cumene (Isopropyl benzene)	98-82-8	Antimony	7440-36-0	Silver	7440-22-4
DDD, 4,4	72-54-8	Arsenic	7440-38-2	Thallium	7440-28-0
DDE, 4,4	72-55-9	Barium	7440-39-3	Vanadium	7440-62-2
DDT, 4,4	50-29-3	Beryllium	7440-41-7	Zinc	7440-66-6

TABLE 1: Screening Parameters for Historic Fill

Regulated Substance	CASRN	Regulated Substance	CASRN	Regulated Substance	CASRN
Dichloroethylene, cis-1,2-	156-59-2	Boron	7440-42-8	Ammonia	7664-41-7
Dieldrin	60-57-1	Cadmium	7440-43-9	Chloride	7647-14-5
Ethylbenzene	100-41-4	Chromium(III)	16065-83-1	Fluoride	7681-49-4
Fluorene	86-73-7	Chromium(VI)	18540-29-9	Sulfate	7757-82-6
Ideno(1,2,3-cd) pyrene	193-39-5	Chromium (total)	7440-47-3		
Napthalene	91-20-3	Cobalt	7440-48-4		

C. Management of Regulated Fill

Regulated fill must be managed in accordance with the Department's municipal or residual waste regulations, 25 Pa. Code § 271.2 and § 287.2, respectively, whichever is applicable, and may be beneficially used in accordance with General Permit No. WMGR096.

Coverage under General Permit No. WMGR096 is not required in the following instances:

1. Remediation activities undertaken entirely on an Act 2 site, pursuant to the requirements of Section 902 of Act 2.

2. When fill from an Act 2 site is used as construction material at a receiving site that is being remediated to attain an Act 2 standard, provided the procedural and substantive requirements of Act 2 and the following are satisfied:

    a. Regulated substances contained in the fill are incorporated into the notice of intent to remediate and the final report for the remediation taking place at the receiving site.

    b. Movement of fill between Act 2 sites is documented in the final reports for both the donor site and receiving site.

    c. Except as provided elsewhere in this policy, placement of the fill does not and will not cause the receiving site undergoing remediation to exceed the selected Act 2 standard.

3. Use of the regulated fill is limited to the excavation, movement or use of the regulated fill within a project area or right-of-way of a project.

A person or municipality interested in obtaining coverage under General Permit No. WMGR096 must apply to the Department in accordance with the application instructions provided in the permit. The terms and conditions of General Permit No. WMGR096 are available on the Department's website.

D. Management of Clean Fill

Pursuant to 25 Pa. Code § 271.101(b)(3) and § 287.101(b)(6), use of clean fill does not require a permit under the SWMA or the municipal or residual waste regulations. Clean fill may be used in accordance with all applicable requirements governing the placement or use of clean fill,

including 25 Pa. Code Chapter 102 (relating to erosion and sediment control) and 25 Pa. Code Chapter 105 (relating to dam safety and waterway management). Persons using fill must also comply with the fugitive emissions regulations under 25 Pa. Code, Chapter 123 (relating to standards for contaminants) issued under the Air Pollution Control Act, 35 P.S. § 4001, and shall comply with all the applicable provisions of 25 Pa. Code §§ 123.1 and 123.2 (relating to prohibition of certain fugitive emissions and fugitive particulate matter). The use of clean fill may be regulated under other environmental laws and regulations.

If the uncontaminated brick, block or concrete from a construction or demolition activity is intended for use as clean fill, best management practices (BMPs) should be followed prior to demolition activities to remove from a building or structure all materials that do not meet the definition of clean fill, such as materials or surfaces covered with lead-based paint, friable asbestos, and hazardous materials such as mercury switches, PCB ballasts, tritium-containing exit signs, and fluorescent light bulbs.

Clean fill may not contain any free liquids based on visual inspection and cannot create a public nuisance (such as an objectionable odor) to users of the receiving site or adjacent properties.

If any person wants to use clean fill under this policy, complete Form FP-001, Certification of Clean Fill, and submit it to DEP electronically on the DEP website at https://www.dep.pa.gov/Business/Land/Waste/SolidWaste/Residual/Pages/default.aspx. Complete and submit the FP-001 prior to movement of clean fill to the receiving site. Complete and submit FP-001 regardless of whether sampling and analysis are performed as part of environmental due diligence.

If the donor site has undergone or is undergoing cleanup or remediation under a local, state or federal regulatory program that requires site characterization, or if the fill proposed to be managed as clean fill has otherwise been subject to analytical testing or other procedures identified in the definition of "environmental due diligence," attach the following to Form FP-001:

- Copies of the sampling plan developed for the fill,
- All laboratory reports,
- Documentation and data associated with a background determination and equivalent site evaluation conducted as part of the fill determination, including the identification and location of point sources, the proximity of identified point sources to the background reference area, identification of areas of imported fill other than imported clean fill, etc.

If a person receives fill from multiple donor sites, a separate Form FP-001 is necessary for each donor site. DEP will accept the completed FP-001 electronically via a link on the DEP website.

If a background demonstration is made, as described in Appendix A of this policy, use the FP-001 to include documentation of the background demonstration along with documentation demonstrating that an equivalent site evaluation has been performed and the provisions of Appendix A have been satisfied.

Both the donor site and the receiving site are responsible for maintaining copies of the completed Form FP-001 for a period of five (5) years. Copies of the form and all supporting documentation, including analytical test reports, should be made available and provided to DEP upon request.

Appendix A
Sample Collection and Analytical Testing Protocol for Performing Environmental Due Diligence

Prior to movement of fill to a receiving site, use Sections B-D of the Management of Fill policy to make a fill determination. Analytical testing of the fill is not necessary unless environmental due diligence indicates a release of a regulated substance. This Appendix provides guidelines for using analytical testing as part of the environmental due diligence.

A. Sampling Plan Development

The first step in a chemical evaluation of fill is to develop a plan for sampling. To use analytical testing as part of the environmental due diligence, develop and implement a scientifically credible sampling plan in accordance with the most recent version of the EPA's publication, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* also known and hereinafter referred to as SW-846, and the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002*. Chapter 9 of SW-846 describes procedures for developing a sampling plan and the statistical treatment of data. Where there is disagreement between the procedures outlined in this Appendix and the referenced EPA documents, follow the procedures contained in this Appendix.

Employ a systematic planning process, such as the Data Quality Objectives Process identified in the *RCRA Waste Sampling Draft Technical Guidance*, to set objectives for the type, quantity and quality of data needed to demonstrate with a known level of assurance that the applicable standards for clean fill or regulated fill are achieved. The level of complexity and detail needed in the sampling plan are directly related to the size, scope and level of complexity of the donor site.

The following are the minimum scientific objectives of a sampling plan developed under this policy:

- Identify and quantify known or suspected contaminants in the fill.
- Collect samples that will allow measurements of the chemical properties of the fill that are both accurate and precise.
- Collect representative samples, which for the purposes of implementing this policy are samples exhibiting typical properties of the whole volume of fill.
- Collect enough samples, and in no case less than eight discrete samples or two composite samples, to sufficiently represent the variability of the fill.
- Obtain a statistically valid and reliable estimate of the fill's chemical properties.

Characterize the fill both horizontally and vertically to represent the entire volume of fill to be transported off the donor site and used at a receiving site. A thorough characterization will provide the following information:

- Identity of regulated substances associated with a release that are present in the fill, the concentration of each identified regulated substance, and the spatial variation in concentration of each regulated substance both horizontally and vertically.

- The physical characteristics of the fill in which the regulated substances associated with a release are present. Examples of these include the fill type (such as soil, rock, dredge), texture, dry bulk density, permeability, organic carbon content, porosity, and moisture content. Include documentation of physical characteristics and any significant variability over the donor site.

In the sampling plan include a summary of existing information about the donor site, including any previously performed sampling or analysis information, preliminary estimates of summary statistics such as the mean and standard deviation, process descriptions and materials used, spatial boundaries of the donor site to be managed under this policy, information about what is known or suspected at the donor site, releases, and release mechanisms. Document this information by written descriptions of site conditions supported by maps, cross-sections, site diagrams, or other descriptive, graphical, or tabular illustrations necessary to characterize the site conditions.

Sampling units for fill managed under this policy should represent the total volume of fill being characterized pursuant to Sections B and C of this Appendix. Sampling plans may include a combination of probability sampling and authoritative sampling designs depending on conditions at the donor site. Probability sampling should be used to characterize the fill as a whole. Some sites may require additional, more focused sampling, such as authoritative sampling, to evaluate problem areas, such as localized areas that are suspected to contain the highest levels of regulated substances, or "hot spots," or areas that may require further evaluation. For example, areas that housed an underground storage tank or experienced a release of regulated substances should be sampled authoritatively and more frequently than other areas of the donor site. The remaining area of the donor site should be sampled using probability sampling, in which all parts of the fill being characterized have a known probability of being included in the characterization. Samples collected to delineate a "hot spot" are typically in addition to those collected for the overall site characterization.

B. Sampling Procedures for Fill Stored in Piles

There are several variables involved in the sampling of fill stored in piles, including the size and shape of the pile, compactness of the fill, and physical properties of the fill. The size and shape of the pile should be used to calculate volume and plan for the correct number of samples to be taken. Simple random sampling or stratified random sampling should be used to obtain representative samples from a fill pile, in accordance with SW-846 and Sections 5.2.1 – 5.2.2, and 5.3 of the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002*. A method of random sampling, such as simple random or stratified random sampling should be used unless one of the following conditions exists:

- There are known distinct strata.

- An objective of the sampling is to prove or disprove that there are distinct strata.

- The number of samples is limited, and an objective of the sampling is to statistically minimize the size of a "hot spot" that might not get sampled.

Stratified random sampling can be employed only if all points within the pile can be accessed. In such cases, the pile should be divided into a three-dimensional grid system. The grid cubes should be numbered, and the grid cubes to be sampled should be chosen by random number tables or generators.

Generally, stainless-steel shovels, trowels, or scoops should be used to clear away surface material before samples are collected. Depth samples may be collected using a decontaminated auger. For a sample core, thin-wall tube samplers or grain samplers may be used. Near surfaces, samples can be collected with a clean, stainless-steel spoon or trowel. All samples collected, except those for VOCs analysis, should be placed into a Teflon-lined or stainless-steel pail and mixed thoroughly before transfer to the appropriate sample container. Since volatilization of VOCs can occur rapidly once the matrix is disturbed, grab samples are necessary for VOCs analysis. Grab samples should be handled as intact cores and transferred immediately to the container that will be used for analysis. Refer to SW-846, Method 5035, for container and preservation details specific to samples for VOCs analysis.

The sampling and subsequent analysis of fill stored in piles may be performed by collecting composite or discrete samples.

1. Procedure for Using Composite Samples:

    a. Do not use composite sampling if the integrity of the individual sample changes because of the physical mixing of discrete samples.

    b. For up to 125 cubic yards of fill, collect and handle eight discrete samples (plus two grab samples for VOCs) as follows:

        i. Prior to compositing, field screen the eight discrete samples to identify the two that are most likely to contain the highest concentrations of VOCs.

        ii. In accordance with SW-846, Method 5035, collect grab samples for VOC analysis from the two points identified by the field screening described above.

        iii. For all other substances, combine the eight discrete samples collected into two composite samples comprised of four discrete samples each. Perform the analysis on the two composite samples in accordance with SW-846.

c. For greater than 125 cubic yards and up to and including 3,000 cubic yards, collect and handle 12 discrete samples (plus three grab samples for VOCs) as follows:

i. Prior to compositing, field screen the 12 discrete samples to identify the three samples that are most likely to contain the highest concentrations of VOCs.

ii. In accordance with SW-846, Method 5035, collect grab samples for VOC analysis from the same sampling points as the three discrete samples identified by field screening.

iii. For all other substances, combine the 12 discrete samples collected into three composite samples comprised of four discrete samples each. Perform the analysis on the three composite samples in accordance with SW-846.

d. For each additional 1,000 cubic yards of fill or part thereof over the initial 3,000 cubic yards, collect four additional discrete samples (plus one grab sample for VOCs). Composite and analyze the four discrete samples in accordance with SW-846.

2. Procedure for Using Discrete Samples:

a. For up to 125 cubic yards of fill, collect and analyze a minimum of eight discrete samples (plus two grab samples for VOCs). For volumes of fill greater than 125 cubic yards and up to and including 3,000 cubic yards, collect and analyze a minimum of 12 discrete samples (plus three grab samples for VOCs). For each additional 1,000 cubic yards of fill or part thereof over the initial 3,000 cubic yards, collect and analyze a minimum of four additional discrete samples (plus one grab sample for VOCs).

b. For VOCs analysis, perform grab sampling as described in subsection B.1 of this Appendix.

C. Sampling Procedures for In-situ Fill

For the purposes of this policy, “in-situ fill” refers to fill that is undisturbed in its original location at the donor site or fill that has previously been used as clean or regulated fill and will be subsequently excavated and moved to a receiving site. If conducting sampling on in-situ fill to evaluate whether that fill can be managed as clean or regulated fill, characterize both the vertical and horizontal extent of the fill to be transported and used at a receiving site. Where multiple zones of contamination are possible due to site-specific conditions, including separate and discrete releases or the manner in which fill was originally placed, the characterization and demonstration that the fill meets the CFCLs or RFCLs apply individually to the separate zones.

For in-situ sampling where the purpose of the sampling is to characterize a specific release at the donor site, discrete samples collected using a focused sampling technique, such as authoritative sampling, must be used for analysis. These areas may be:

- Localized areas that are known to contain levels of regulated substances that exceed the CFCLs or RFCLs, whichever is applicable, based on analytical results, or

- Localized areas suspected to contain levels of regulated substances that exceed the CFCLs or RFCLs from a specific release, whichever is applicable, based on the historic use of the site.

Once the specific release at the donor site has been characterized, composite samples may be used to confirm that the remaining fill to be excavated and transported to a receiving site and used as clean or regulated fill meets the CFCLs or RFCLs, respectively.

To characterize the remaining area, the area should be sampled using a method of random sampling, such as simple random or stratified random sampling. Composite samples can then be used to verify that the fill intended for excavation and transportation meet the CFCLs or RFCLs, whichever is applicable. When composite samples are utilized for in-situ samples, the sampling plan must demonstrate that localized areas that are known to contain regulated substances exceeding the CFCLs or RFCLs, whichever is applicable, are not included in the portion of the site evaluated using composite samples.

Apart from known hot spots, which may require further sampling and analysis, as discussed above, the donor site should be divided into a three-dimensional grid. Where possible, each grid unit should be of similar size and shape and be comprised of equal volumes of fill. A method of random sampling, such as simple random or stratified random sampling, should be chosen based on knowledge of the donor site as set forth in SW-846 or the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002*.

The number of sample points is determined by the volume of fill being characterized. Sampling frequency should account for the depth of donor fill to be removed. If an area of donor fill will be excavated to more than one depth (for example, three feet in one part and six feet in another part), then the samples should be distributed accordingly at multiple depths to be representative of the full depth of each cut. Determine the minimum number of samples using the procedure outlined in subsection B.2 of this Appendix. Additional sampling may be necessary based on site-specific conditions.

D. Evaluation of Data

Evaluate sample data generated in accordance with Sections B and C of this Appendix in accordance with the following:

1. For a composite sample collected in accordance with subsection B.1, the measured numeric value for a parameter may not exceed the CFCL for that parameter for the fill to be managed as clean fill, or the RFCL for that parameter for the fill to be managed as regulated fill.

2. For a grab sample collected for VOC analysis in accordance with the above sections, the measured numeric value for a parameter may not exceed the CFCL for that parameter for the fill to be managed as clean fill, or the RFCL for that parameter for the fill to be managed as regulated fill.

3. For discrete samples collected in accordance with subsection B.2, the measured numeric values for a substance in 75% of the discrete samples may not exceed the CFCL for that parameter for the fill to be managed as clean fill, or the RFCL for that parameter for the fill to be managed as regulated fill. For persons using the discrete sampling method, no single sample may show regulated substances at a concentration that is more than twice the CFCL or RFCL, whichever is applicable, for any parameter.

E. Alternate Evaluation of Data

In lieu of Section D of this Appendix, a person may use the 95% Upper Confidence Limit (UCL) of the arithmetic mean to determine whether the fill meets the CFCL or RFCL, whichever is appropriate, for a parameter. The calculated 95% UCL of the arithmetic mean should be below the appropriate CFCL or RFCL for that parameter. Persons intending to use this method for the treatment of data should determine a minimum number of samples in accordance with SW-846 and the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002*. The application of the 95% UCL of the arithmetic mean should comply with the following performance standards:

1. The null hypotheses (Ho) is that the true arithmetic average concentration is at or above the CFCL or RFCL for that parameter, whichever is appropriate, and the alternative hypothesis (Ha) is that the true arithmetic average concentration is below the CFCL or RFCL for that parameter, whichever is appropriate.

2. Meet the underlying assumptions of the statistical method, such as data distribution.

3. Compositing cannot be used for VOCs.

4. The censoring level for each non-detect is the assigned value randomly generated that is between zero and the limit related to the practical quantitation limit (PQL).

5. Tests should account for spatial variability, unless otherwise approved by the Department.

6. Statistical testing should be done individually for each parameter for which a single sample result or multiple results exceed(s) a limit.

7. Where a fill has distinct physical, chemical or biological characteristics, or originates from different areas, do the statistical testing separately.

8. Document the following information:

    a. A description of the original areas of the fill and physical, chemical and biological characteristics of the fill.

b. A description of the underlying assumptions of the statistical method.

c. Documentation showing that the sample data set meets the underlying assumptions of the statistical method.

d. Documentation of input and output data for the statistical test, presented in tables or figures, or both, as appropriate.

e. An interpretation and conclusion of the statistical test.

F. Use of the Synthetic Precipitation Leaching Procedure (SPLP, SW-846 Method 1312) to Establish an Alternative Soil-to-Groundwater Value

Fill may be analyzed using SPLP to provide an alternative soil-to-groundwater value for use in making a fill determination. The value obtained using the SPLP represents a concentration of a regulated substance in the fill that does not produce leachate in which the concentration of the regulated substance exceeds the applicable groundwater MSC identified in Table 1 [MSCs for Organic Regulated Substances in Groundwater] or 2 [MSCs for Inorganic Regulated Substances in Groundwater] of Appendix A in 25 Pa. Code, Chapter 250. For both clean and regulated fill, the groundwater MSC for used aquifers with TDS <2,500 mg/L should be used to compare the SPLP result to Tables 1 or 2. For clean fill, use the groundwater MSC for residential use ("R") for comparison. For regulated fill, use the groundwater MSC for non-residential use ("NR") for comparison. If SPLP is used to identify an alternative soil-to-groundwater value, the alternative value is only applicable to the fill that was tested using SPLP.

Use the following procedure to determine an alternative soil-to-groundwater value based upon the SPLP:

1. During characterization of the donor site, obtain a minimum of ten samples from the proposed fill. For volumes of fill less than 125 cubic yards, collection of a minimum of eight samples is acceptable. Submit the four samples with the highest total concentration of the regulated substance for SPLP analysis. Samples obtained will be representative of the soil type and horizon impacted by the release of the regulated substance.

2. Determine the lowest total concentration (TC) that generates a failing SPLP result. The alternative soil-to-groundwater value will be the next lowest TC.

3. If all samples result in a passing SPLP level, the alternative soil-to-groundwater value will be the TC corresponding to the highest SPLP result. Additional samples may be collected.

4. If none of the samples generates a passing SPLP, additional samples may be collected and concurrent TC/SPLP analyses performed to satisfy the above conditions for establishing an alternative soil-to-groundwater value.

5. The alternative soil-to-groundwater value is then compared to the direct contact residential value for clean fill or the direct contact non-residential value for regulated fill

found in Chapter 250, Appendix A, Tables 3[6] or 4[7]. The lower of the compared values is the applicable numeric limit.

G. Performing a Background Demonstration and Equivalent Site Evaluation

A background demonstration may be utilized for both clean fill and regulated fill determinations. For clean fill determinations, use the CFCLs. For regulated fill, use the RFCLs. If fill from the donor site contains regulated substances at concentrations exceeding the CFCL or RFCL, whichever is appropriate, for that parameter, a demonstration may be made to show that the exceedance is due to background at the donor site. If a successful background demonstration is made, perform an equivalent site evaluation prior to movement of fill to a receiving site. The equivalent site evaluation ensures that no new regulated substance is placed on the receiving site other than a regulated substance already determined to be present and that the concentration(s) of regulated substance(s) in the donor fill has been compared to the concentration(s) of the same regulated substance(s) at the receiving site in accordance with subparagraphs G.3.b.i-ii. of this Appendix. Regulated substances detected in the donor fill that are below the CFCL or RFCL, whichever is appropriate, for that parameter, do not require a background demonstration or an equivalent site evaluation.

Generally, only naturally occurring metals, lead and some ubiquitous organics, such as polynuclear aromatic hydrocarbons (PAHs), from widespread atmospheric deposition, are eligible for a background demonstration. When data or other information indicates that a regulated substance has migrated onto the donor site from the release of a regulated substance at another site, the regulated substance is not due to background of that substance at the donor site. Pathways for the migration of a regulated substance due to an offsite release include surface runoff from specific sources (such as runoff from parking lots and storage facilities where spills have occurred); spills at railroad facilities and in railroad rights-of-way; and air deposition of regulated substances from specific sources.

Previously collected background data published by an accredited source with appropriate peer review may be considered, provided the information is sufficiently focused and contains the level of detail on the area used to determine background necessary to legitimately compare it to the donor site. The description of the sampling and analysis performed should be detailed enough to provide statistical validity.

Use the following guidelines when performing a background demonstration under this policy:

1. Select a Background Reference Area:

   The first step in making a demonstration that the presence of a regulated substance is due to background at the donor site and is not due to a release is to select a background reference area, as the term is defined in this policy, to collect samples for the purpose of establishing background at the donor site. Samples may be collected from the background reference area to demonstrate that an exceedance of a CFCL or RFCL, as appropriate, can be attributed to background, as the term is defined in this policy. Background reference areas should not include areas affected by a known or suspected

[6] Direct contact numeric values for soils at residential properties
[7] Direct contact numeric values for soils at non-residential properties

release of a regulated substance, including areas impacted by road runoff, areas near railroads affected by engine exhaust contaminants, and areas near buildings contaminated by paint chips. In urban areas, background reference areas may include areas where widespread, ubiquitous contamination is present that cannot be traced to a specific source.

Background reference areas should be as similar as possible to the donor site. Every attempt should be made to reduce the factors that are different between the background reference area and the donor site. This does not mean that a sample collected at a location that is a considerable distance from an area known or suspected to have been affected by a release of a regulated substance is unacceptable merely because the known or suspected regulated substance is detected in the sample. The presence of regulated substance outside of the area known or suspected to have been affected by a release may indicate that the presence of the regulated substance is truly ubiquitous, widespread and incapable of being traced to a specific source. In this case, the regulated substance may be part of the background at the donor site.

A background reference area, as the term is defined in this policy, should be selected for use in the background demonstration.

2. Sampling, Analysis and Evaluation of Data:

Establish background by a sampling methodology that is statistically valid and consistent with the methodology used to perform the fill determination. Use the same analysis methods for the background samples that were used for performing the fill determination.

Compare the analytical results of the background samples with the results obtained from the fill determination. Use the following statistical methods for the comparison:

a. Demonstrate that the highest measurement from the donor site is not greater than the highest measurement from the background reference area. The Department may accept insignificant variances in numbers. The minimum number of samples to be collected is 10 from the background reference area and 10 from each donor site. Analysis should be carried out on discrete samples.

b. The Department may accept another appropriate statistical method if it meets the conditions below.

    i. For nonparametric and parametric methods, the false-positive rate for a set of data applied to a statistical test may not be greater than 0.05. The minimum number of samples to be collected is 10 from the background reference area and 10 from each donor site.

    ii. For parametric methods, the censoring level for each non-detect (ND) should be the assigned value randomly generated that is between zero and the limit related to the PQL.

3. Equivalent Site Evaluation:

The equivalent site evaluation ensures that no new regulated substance is placed on the receiving site other than a regulated substance that is already determined to be present and that the concentration(s) of regulated substance(s) in the donor fill has been compared to the concentration(s) of the same regulated substance(s) at the receiving site in accordance with subparagraphs G.3.b.i-ii. of this Appendix. Regulated substances detected in the donor fill that are below the CFCLs or RFCLs, as appropriate do not need to be included in the equivalent site evaluation. Perform the equivalent site evaluation prior to the movement of fill to a receiving site. Include documentation in the FP-001 demonstrating that the equivalent site evaluation has been performed and is satisfied in accordance with this section.

a. Develop a Plan for Sampling the Receiving Site.

Make a background determination on the receiving site to determine whether the same regulated substances present in the donor fill due to background are also present at the receiving site, and if so, determine the concentrations of the identified regulated substances. Development of a sampling plan in accordance with Section A of this Appendix is necessary to characterize the receiving site.

In the sampling plan include a summary of existing information about the receiving site, including any previously performed sampling or analysis information, process descriptions and materials used, spatial boundaries of the receiving site, information about what is known or suspected at the receiving site, releases, and release mechanisms. Document this information by written descriptions of site conditions and supported by maps, cross-sections, site diagrams, or other descriptive, graphical, or tabular illustrations necessary to characterize the site conditions.

The receiving site should be sampled using probability sampling, in which all parts of the site being characterized have a known probability of being included in the characterization, except for areas of the receiving site that are known to be or suspected of being affected by a release of a regulated substance, including areas impacted by road runoff, areas near railroads affected by engine exhaust contaminants, and areas near buildings contaminated by paint chips, unless the entire receiving site is part of a larger urban area where ubiquitous, widespread contamination is present that is incapable of being traced to a specific source.

Select the area of the receiving site used for the equivalent site evaluation in accordance with the following:

i. The area sampled is unaffected by a release of a regulated substance.

ii. The area sampled should be at a depth comparable to the area where donor fill is to be placed on the receiving site.

iii. The concentration of regulated substances in the area sampled is attributable to the parent material from which the soil was derived and the

natural processes which produce soil; or the concentrations of regulated substances resulted from an atmospheric deposition, as the term is described in the definition of "background reference area," but are not attributable to a specific point source or release of a regulate substance.

b. Sampling, Analysis and Evaluation of Data.

Establish the background by a sampling methodology that is statistically valid and consistent with the methodology used to perform the fill determination. Use the same analysis methods for background samples that were used for performing the fill determination.

Compare the analytical results of background samples for the receiving site with the results obtained from the donor fill. Use one of the following statistical methods for comparison:

i. Demonstrate that the highest measurement from the donor site is not greater than the highest measurement from the receiving site. The Department may accept insignificant variances in numbers. The minimum number of samples to be collected is 10 from the receiving site and 10 from each donor site.

ii. The Department may accept another appropriate statistical method if it meets the conditions below.

(A) For nonparametric and parametric methods, the false-positive rate for a set of data applied to a statistical test may not be greater than 0.05. The minimum number of samples to be collected is 10 from the receiving site and 10 from each donor site.

(B) For parametric methods, the censoring level for each non-detect (ND) should be the assigned value randomly generated that is between zero and the limit related to the PQL.

Appendix B
Recognition and Identification of Acid-Producing Rock

Pennsylvania's municipal and residual waste regulations define clean fill, in part, as inert solid material. Acid-producing rock reacts when exposed to air or water and therefore does not meet the regulatory definition of clean fill. In addition to presenting abrupt and adverse environmental concerns, exposed acid-producing rock can also have long-term damaging effects on highways and highway structures, including corrosion of concrete and steel structures; destabilization of cut slopes and fill slopes; ground heaving of structures and pavements; toxicity to roadside vegetation and aquatic life; and degradation of drinking water supplies.

Determining whether or not fill contains acid-producing rock begins with determining the presence of or likelihood of encountering acid-bearing rock (ABR), which is widespread in Pennsylvania. The primary source of acidity in Pennsylvania sedimentary rocks is sulfide minerals. Although there are many minerals that contain sulfur, those containing pyrite, or ferrous disulfide, are the major contributors to the release of acid. While pyrite minerals are not always large enough to be visible to the unaided eye, larger crystals have a yellowish, metallic appearance. Deposits containing pyrite concentrations greater than 0.5% have the potential to be significant sources of acid. Various other forms of sulfide minerals are of lesser concern due to their chemical stability, and include chalcopyrite (CuFeS2), galena (PbS) and sphalerite (ZnS), but can be problematic when present with pyrite.

Although there are more than 200 common minerals that contain sulfur, only those classified as iron sulfide are of potential concern due to the ability of these elements to promote oxidation, hydration and the release of acid. In Pennsylvania, there are four potential sulfide deposit types, listed as follows in descending order of pyrite oxidation reactivity:

- Veined Rock Deposits;
- Sedimentary Rock Deposits;
- Mine Spoils; and
- Acid Sulfate Soil Deposits.

Typically, the upper 25- to 35-feet of bedrock does not contain pyrite because pyrite is not stable under atmospheric conditions and will weather away. Therefore, if excavations are shallower than 30 feet, the risk of acid release is generally minimal. This is particularly true if a site is located south of the glacial margin. Within the glaciated regions of Pennsylvania, weathered bedrock may have been removed by glaciers and pyrite may exist closer to the surface. Unconsolidated sediments, such as glacial till, sand, and gravel, are not acid-producing and can be excavated without risk of acidic drainage. With regard to characterization of fill excavated to depths greater than 25 feet, environmental due diligence should include details demonstrating that the fill does not contain acid-producing rock.

The following publicly available resources may also assist in assessing the likelihood of encountering ABR:

- The Pennsylvania Geological Survey's a map of potentially acid bearing rocks (OFMI Report 05-01.1);
- The Pennsylvania Department of Transportation's (PennDOT) Geotechnical Engineering Manual, Publication 293 (4/18) (PUB 293 (4/18)); and
- DEP's Fact Sheet titled, "How to Avoid and Handle Acid-Producing Rock Formations Encountered During Well Site Development" (PA DEP Link)

If ABR is anticipated in the fill based on published information or identified during due diligence, testing should be done to estimate the acid-producing potential. For more information on testing procedures and acid-base accounting procedures, please refer to PennDOT's "Geotechnical Engineering Manual, Publication 293 (4/18) (PUB 293 (4/18))," DEP's "Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania (Coal Mine Drainage Prediction and Pollution Prevention)" or DEP's "Evaluation of Acid-Base Accounting Using Computer Spreadsheets (Evaluation of Acid-Base Accounting)."

SECTION 01 1000

SUMMARY

GENERAL

RELATED DOCUMENTS

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

SUMMARY

Section Includes:

Project information.
Work covered by Contract Documents.
Owner-furnished/Contractor-installed (OFCI) products.
Owner-furnished/Owner-installed (OFOI) products.
Contractor-furnished/Delegated Design products- Grandstand.
Contractor's use of site and premises.
Work restrictions.
Specification and Drawing conventions.
Miscellaneous provisions.

Related Requirements:

Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
Section 017300 "Execution" for coordination of Owner-installed products.
Section 012500 SUBSTITUTION REQUEST FORM

DEFINITIONS

Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

PROJECT INFORMATION

A. Project Identification: PSUH Stadium Seating and Restroom Building

Project Location: <<< \ Mfwwxgzwl Umpj1R niiqjyt | s1UF 6<5:<

Owner: Penn State University, Harrisburg, <<< \ Mfwwxgzwl Umpj1R niiqjyt | s1UF 6<5:<

Owner's Representative: Douglas Wenger, LA P: 814.863.9622, jdw132@psu.edu

B. Architect: Weber Murphy Fox, 403 S. Allen, State College, PA. 16801

Architect's Representative: Dennis Wilkins P:814 920 1926 dwilkins@wmf-inc.com

C. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

Structural: Diviney and Associates, 310 Penn Street, Suite 104, Hollidaysburg, PA 16648

Structural Representative: Randy Diviney P: 814-317-5037, rdiviney@DAStructures.com

Mechanical, Electrical, Plumbing, and Fire Protection: Barton Associates. SCC North Buidling, 221 W. Philadelphia St', York, PA 17401

MEP Representative: Bob Sells. 717-817-2285. ras@ba-inc.com

Civil: K & W Engineers, 2201 N. Street, suite 200. Harrisburg, PA 17110

Civil Representative: Marc Singley. 717-635-2835, x:1015
msingley@kandwengineers.com

WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project: New bleachers and press box in addition to a restroom building are proposed to be built on the site of an existing soccer field. The bleachers will accommodate 735 spectators. The press box will be accessed through the bleachers. The new restroom one-story building (2,826 sq ft) will include public restrooms, storage for athletic items, and covered storage for a gator and field maintenance equipment. A new paved road will connect the existing parking in front of the EAB building to the concession building. Accessible parking will be added to the existing parking lot. Site work will also include a concrete public plaza in front of the restroom building and a path to the bleachers., and new utilities extension as indicated on drawings.

B. Type of Contract: Single contract, C-1

C. Work by Owner: Indicated on drawings as notes.

D. Owner-Furnished, Contractor-Installed (OFCI) Products: Indicated on drawings as notes

E. Use of Site: Limited to work in areas indicated on drawings.

F. Owner's Occupancy Requirements: Access to the soccer field should be maintained during construction

OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
Provide for delivery of Owner-furnished products to Project site.
Upon delivery, inspect, with Contractor present, delivered items. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

Obtain manufacturer's inspections, service, and warranties.
Inform Contractor of earliest available delivery date for Owner-furnished products.

Contractor's Responsibilities: The Work includes the following, as applicable:

Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing Owner-furnished products in the Work.

Receive, unload, handle, store, protect, and install Owner-furnished products.
Make building services connections for Owner-furnished products.
Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.

Repair or replace Owner-furnished products damaged following receipt.

Owner-Furnished/Contractor-Installed (OFCI) Products:
Refrigerator, under counter refrigerator in press box
TV in press box
Ice machine
Soap dispensers
Toilet paper dispensers
Sanitary napkin disposals
Sanitary napkins dispenser
IT racks

And as indicated on the drawings.

OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

The Owner will furnish and install
Fiber optic cabling (conduit by EC)

And as indicated on the drawings.

CONTRACTOR-FURNISHED/DELEGATED DESIGN PRODUCTS- GRANDSTAND

Contractor's Responsibilities for the Grandstand: The Work includes the following, as applicable:

Designate delivery dates of all products for use in project for the grandstand including bleachers and press box.

Suggested grandstand structure alternate methods can be proposed as a substitution request during bidding as long as seating number, ADA access and room for designated storage is maintained.

CONTRACTOR'S USE OF SITE AND PREMISES

Unrestricted Use of Site: Contractor shall make 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.

D. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project’s site beyond areas in which the Work is indicated.

Limits on Use of Site: Confine construction operations to limits of disturbance indicated on the Civil drawings, and site logistics plan.

Limits: Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet beyond building perimeter; 10 feet beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.

Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

Schedule deliveries to minimize use of driveways and entrances by construction operations.

Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

WORK RESTRICTIONS

Comply with restrictions on construction operations.

Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

On-Site Work Hours: Limit work to between 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

On-Site Work Day Restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during work black-out days as determined by Campus Operations.

F. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

Notify Owner not less than ten days in advance of proposed utility interruptions.
Obtain owner's written permission before proceeding with utility interruptions.

Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

Notify Owner's not less than **ten** days in advance of proposed disruptive operations.
Obtain owner's written permission before proceeding with disruptive operations.

G. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

H. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

I. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

Maintain list of approved screened personnel with Owner's representative.

SPECIFICATION AND DRAWING CONVENTIONS

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:

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.

Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.

Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.

Specification requirements are to be performed by Contractor unless specifically stated otherwise.

Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

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

K. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.

Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PRODUCTS (Not Used)

EXECUTION (Not Used)
END OF SECTION

SECTION 01 2100

ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.

C. Related Requirements:

1. Section 01 2200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
2. Section 01 2600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
3. Section 01 4000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

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

1.5 ACTION SUBMITTALS

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

1.6 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.

1.7 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight**,** and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight**,** and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.9 QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight**,** and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.10 CONTINGENCY 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 contingency 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 contingency allowance will include Contractor's related costs and reasonable overhead and profit.

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

1.11 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, required maintenance materials, 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 markups.
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 due to a change in the 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: _____

1. Coordinate quantity allowance adjustment with unit-price requirements in Section 01 2200 "Unit Prices."

END OF SECTION

SECTION 01 2500

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

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

1. 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.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form acceptable to Architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitutions 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.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. Certificates and qualification data, where applicable or requested.
    g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.

h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. 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.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. 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.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within fifteen days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Requested substitution provides sustainable design characteristics that specified product provided for compliance with LEED requirements.
      c. Requested substitution provides sustainable design characteristics that specified product provided for compliance with IgCC requirements.
      d. Requested substitution provides sustainable design characteristics that specified product provided for compliance with ASHRAE 189.1 requirements.

e. Requested substitution provides sustainable design characteristics that specified product provided for compliance with Green Globes requirements.
f. Substitution request is fully documented and properly submitted.
g. Requested substitution will not adversely affect Contractor's construction schedule.
h. Requested substitution has received necessary approvals of authorities having jurisdiction.
i. Requested substitution is compatible with other portions of the Work.
j. Requested substitution has been coordinated with other portions of the Work.
k. Requested substitution provides specified warranty.
l. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

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

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Requested substitution provides sustainable design characteristics that specified product provided for compliance with LEED requirements.
e. Requested substitution provides sustainable design characteristics that specified product provided for compliance with IgCC requirements.
f. Requested substitution provides sustainable design characteristics that specified product provided for compliance with ASHRAE 189.1 requirements.
g. Requested substitution provides sustainable design characteristics that specified product provided for compliance with Green Globes requirements.
h. Substitution request is fully documented and properly submitted.
i. Requested substitution will not adversely affect Contractor's construction schedule.
j. Requested substitution has received necessary approvals of authorities having jurisdiction.
k. Requested substitution is compatible with other portions of the Work.
l. Requested substitution has been coordinated with other portions of the Work.
m. Requested substitution provides specified warranty.
n. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012500 - SUBSTITUTION REQUEST FORM

Document 012500.01
SUBSTITUTION REQUEST FORM

This 4-page Substitution Request Form is to be **FULLY** completed by the Constructor and attached to **ALL** substitutions for this Project. Use additional sheets as needed. Attach supporting / substantiating documentation to this form. Modifications to form: Prohibited.

PART A: GENERAL SUBMITTAL INFORMATION:
Penn State Harrisburg
Stadium Seating & Restroom Building

A.1: ARCHITECT:
Weber Murphy Fox, Inc.

A.2: CONSTRUCTOR / Contractor
Name: _____

A.3: SUBCONTRACTOR: Contact Information

Name: _____

Address: _____

Phone Number: _____

A.4: VENDOR: Company Contact Information
Name: _____

Address: _____

Phone Number: _____

A.5: DATE SUBMITTED TO CONSTRUCTOR:_____

A.6: DATE SUBMITTED TO A/E:_____

A.7: SUBMITTAL NUMBER:_____

A.8: **SPECIFICATION SECTION REFERENCE:**_____

A.9: SPECIFICATION PAGE NUMBER:_____

A.10: SPECIFICATION ARTICLE NUMBER:_____

A.11: DRAWING SHEET NUMBER(s):_____

A.12 DETAIL SHEET NUMBER(s):_____

A.13: CHANGE TO CONTRACT SUM:
Savings to Owner for accepting substitution: $_____

A.14: CHANGE TO PROJECT SCHEDULE, TOTAL:
☐ None ☐ Yes [Add] [Deduct] # Calendar Days:_____

A.15 ATTACHMENTS: Label each page with Submittal Number
Attach supporting documentation sufficient for Architect to evaluate substitution. Forms submitted without adequate documentation will be returned without review. Samples required with each form.

- ☐ Product Data
- ☐ Drawings
- ☐ Samples
- ☐ Reports
- ☐ Tests
- ☐ Warranties
- ☐ MSDS
- ☐ Schedules
- ☐ Calculations
- ☐ 3rd Party Certification

PART B: REASON FOR SUBSTITUTION: Check all which apply. Attach evidence / supporting documentation for each.

B.1: SPECIFIED PRODUCT….
- ☐ Is no longer available.
- ☐ Is unable to meet project schedule.
- ☐ Is unsuitable for the designated application
- ☐ Cannot interface with adjacent materials
- ☐ Cannot provide the specified warranty
- ☐ Cannot be constructed as indicated
- ☐ Cannot be obtained due to one or more of the following: ☐ Bankruptcy of manufacturer or supplier
  ☐ Strike ☐ Lockout ☐ Similar Occurrence (explain)

☐ Other: _____

B.2: PROPOSED PRODUCT….
- ☐ Will reduce material lead time, # Calendar Days:_____
- ☐ Will reduce material installation time, # Calendar Days:_____
- ☐ Is for supplier's convenience
- ☐ Is for subcontractor's convenience
- ☐ Other: _____

B.3 SCOPE OF SUBSTITUTION: Describe the extents of the substitution and how it may impact related work.

_____

_____

PART C: PROPOSED PRODUCT INFORMATION: Attach complete documentation

C.1: Product Description / Name: _____

C.2: Specified Manufacturer: _____ Model Number: _____

C.3: Proposed Manufacturer: _____ Model Number: _____
(company name & address)
_____

C.4: Manufacturer's Contact Info: Name: _____ Phone Number: _____

C.5: Deviation from Contract Documents? ☐ NO Deviations ☐ YES (attach complete documentation)

C.6: LEED Data Sheet required? ☐ NO ☐ YES (attach complete documentation)

C.7: LEED Data Sheet submitted? ☐ NO ☐ YES (attach complete documentation)

C.8: Lead Time (in weeks) after Approval: _____ C.9: Maintenance Service Available? ☐ NO ☐ Yes

C.10: Date (yyyy-mm-dd) Items Required at Project Site:_____ C.11: Warranty: ☐ NO ☐ Yes, Years: _____

C.12 Age of product availability in USA Marketplace: _____ C.13: Country of Origin: _____

C.14 COMPARISON BETWEEN PROPOSED PRODUCT WITH SPECIFIED PRODUCT: Provide point-by-point comparison

PROPOSED PRODUCT	SPECIFIED PRODUCT
1: _____	1: _____
2: _____	2: _____
3: _____	3: _____
4: _____	4: _____
5: _____	5: _____
6: _____	6: _____
7: _____	7: _____
8: _____	8: _____

Continue comparison / list of deviations on attachment.

C.13: SIMILAR INSTALLATIONS: List minimum of three similar installations within 250 miles of this project's site.

PROJECT 1: PROJECT NAME: _____ Project Completion Date: _____

PROJECT ADDRESS: _____

OWNER'S NAME & CONTACT INFO: _____

ARCHITECT'S NAME & CONTACT INFO: _____

PROJECT 2: PROJECT NAME: _____ Project Completion Date: _____

PROJECT ADDRESS: _____

OWNER'S NAME & CONTACT INFO: _____

ARCHITECT'S NAME & CONTACT INFO: _____

PROJECT 3: PROJECT NAME: _____ Project Completion Date: _____

PROJECT ADDRESS: _____

OWNER'S NAME & CONTACT INFO: _____

ARCHITECT'S NAME & CONTACT INFO: _____

PART D: SUBCONTRACTOR COORDINATION IS REQUIRED WITH WORK IN THESE DIVISIONS

☐ 02 ☐ 03 ☐ 04 ☐ 05 ☐ 06 ☐ 07 ☐ 08 ☐ 09 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14
☐ 21 ☐ 22 ☐ 23 ☐ 25 ☐ 26 ☐ 27 ☐ 28 ☐ 31 ☐ 32 ☐ 33 (Constructor mark all that apply)

D.1: DESCRIPTION OF HOW PROPOSED SUBSTITUTION AFFECTS OTHER WORK OR TRADES:

_____

_____

D.2: IMPACT TO CONTRACT DOCUMENTS:
Proposed substitution dimensionally changes or otherwise impacts the contract document and requires revisions to contract documents. ☐ NO ☐ YES, Explain. Attach copies of contract documents showing impact at each instance.

_____

_____

_____

_____

PART F: CONTRACTOR'S AFFIDAVIT: The Constructor certifies product submitted complies with the project LEED Certificate requirements and with the Specified Requirements by initialing each line below:

REQUIREMENT	INITIALS	REQUIREMENT	INITIALS
1: Investigating for code compliance	_____	9: VOC Verification	_____
2: Independent Verification Testing	_____	10: Warranties and Guarantees	_____
3: Calculation for Percentage of Project	_____	11: Cost Data (include as attachment)	_____
4: Calculation for Recycled Content	_____	12: Coordination with interfacing products and systems	_____
5: Investigated the proposed substitution and believe that it is equal to or superior in all respects to specified product, except as stated herein	_____	13: Constructor will pay any redesign fees incurred by the Architect or any of the Architect's consultants and any special inspection costs incurred by the Owner, caused by the use of this product	_____
6: Constructor waives all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.	_____		

7: The Architect's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered and Addendum is issued; and that Architect's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed. Initials: _____

8: If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product. Initials: _____

F.14: Company Name Submitted By: _____

F.15 Company Address Submitted By: _____

F.16: Authorized Signature: _____

F.17 Printed Name:_____ Date Signed:_____

PART G: RESPONSE DATE Requested Response Date *: _____

List date by which response by Architect is requested to maintain project schedule and allow sufficient time for inclusion of proposed substitution. * Shall be not less than 10 business days from date substitution request is received.

PART G: ARCHITECT'S REVIEW AND ACTION: This section to be completed by Architect

☐ SUBSTITUTION IS ACCEPTED
☐ SUBSTITUTION IS ACCEPTED W/ COMMENTS
_____
_____

RESUBMIT SUBSTITUTION REQUEST
☐ Request Form is not properly executed
☐ Provide proposal indicating amount of savings or credit to Owner.
☐ Other: _____

Reviewer: _____ Date: _____

SUBSTITUTION IS **NOT** ACCEPTED:
☐ Request not received directly from Constructor.
☐ Request not submitted in accordance with requirements.
☐ Request Form is not properly executed.
☐ Request does not indicate what item is being proposed.
☐ Insufficient information submitted for proper evaluation.
☐ Proposed product does not appear to comply with Specified requirements.
☐ Proposed product will require substantial revisions to the Contract Documents.
☐ Other: _____

Architect has relied upon the information provided by the Constructor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

PART H: ARCHITECT'S CONSULTANT REVIEW AND ACTION: This section to be completed by Architect's Consultant.

☐ SUBSTITUTION IS ACCEPTED
☐ SUBSTITUTION IS ACCEPTED W/ COMMENTS
_____
_____

RESUBMIT SUBSTITUTION REQUEST
☐ Request Form is not properly executed
☐ Provide proposal indicating amount of savings or credit to Owner.
☐ Other: _____

Reviewer: _____ Date: _____

SUBSTITUTION IS **NOT** ACCEPTED:
☐ Request not received directly from Constructor.
☐ Request not submitted in accordance with requirements.
☐ Request Form is not properly executed.
☐ Request does not indicate what item is being proposed.
☐ Insufficient information submitted for proper evaluation.
☐ Proposed product does not appear to comply with Specified requirements.
☐ Proposed product will require substantial revisions to the Contract Documents.
☐ Other: _____

PART I: OWNER'S REVIEW AND ACTION: This section to be completed by Owner.

☐ SUBSTITUTION IS ACCEPTED ☐ SUBSTITUTION IS **NOT** ACCEPTED

OWNER'S REPRESENTATIVE (Print Name): _____Dated Signed: _____

OWNER'S REPRESENTATIVE (Signature): _____

COMMENTS: _____

_____

_____

_____

- continued on next page -

PART J: LIST OF ATTACHMENTS: In the space below, list each attachment, and quantity of pages for each. Mark each page with Attachment and Substitution request number.

J.01: ATTACHMENT 01: _____ Pages: _____

J.02: ATTACHMENT 02: _____ Pages: _____

J.03: ATTACHMENT 03: _____ Pages: _____

J.04: ATTACHMENT 04: _____ Pages: _____

J.05: ATTACHMENT 05: _____ Pages: _____

J.06: ATTACHMENT 06: _____ Pages: _____

J.07: ATTACHMENT 07: _____ Pages: _____

J.08: ATTACHMENT 08: _____ Pages: _____

J.09: ATTACHMENT 09: _____ Pages: _____

J.10: ATTACHMENT 10: _____ Pages: _____

J.11: ATTACHMENT 11: _____ Pages: _____

J.12: ATTACHMENT 12: _____ Pages: _____

J.13: ATTACHMENT 13: _____ Pages: _____

J.14: ATTACHMENT 14: _____ Pages: _____

J.15: ATTACHMENT 15: _____ Pages: _____

J.16: ATTACHMENT 16: _____ Pages: _____

J.17: ATTACHMENT 17: _____ Pages: _____

J.18: ATTACHMENT 18: _____ Pages: _____

J.19: ATTACHMENT 19: _____ Pages: _____

J.20: ATTACHMENT 20: _____ Pages: _____

J.21: ATTACHMENT 21: _____ Pages: _____

J.22: ATTACHMENT 22: _____ Pages: _____

- END OF FORM –

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SECTION 01 2600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 01 3100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

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. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, 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.
    e. Quotation Form: Use forms acceptable to Architect.

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 Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction 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 Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 WORK CHANGE DIRECTIVE

A. Work Change Directive: Architect may issue a Work Change Directive. Work 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

SECTION 01 2900

PAYMENT PROCEDURES

PART 1 - GENERAL: NOTE: The PSU eBuilder Payment Procedures must be followed, this section included for reference only.

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
2. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
3. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
4. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
5. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
6. Section 018113.14 "Sustainable Design Requirements - LEED v4 BD+C" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: Submit Application for Payment to Architect by the 20th of the month. The period covered by each Application for Payment is one month, ending on the last day of each month.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

1. .

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: one electronic signed and notarized copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. This electronic copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment, subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

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

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Sustainable design action plans, including preliminary project materials cost data.

7. Schedule of unit prices.
8. Submittal schedule (preliminary if not final).
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
11. Copies of building permits.
12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
13. Initial progress report.
14. Report of preconstruction conference.
15. Certificates of insurance and insurance policies.
16. Performance and payment bonds.
17. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 3100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. RFIs.
   4. Digital project management procedures.
   5. Web-based Project management software package.
   6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:
   1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
   2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
   4. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

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. Coordination of Multiple Contracts: Each contractor shall cooperate with Project coordinator, who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. 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.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors and direction of Project coordinator 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.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    f. Indicate required installation sequences.
    g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
    h. Provide drawings indicting all exposed to view materials, services, and proposed routing.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
    a. Runs of vertical and horizontal conduit.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.

c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
   a. Same digital data software program, version, and operating system as original Drawings.
   b. Revit, Version 2020, operating in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and PDF format.
3. BIM File Incorporation: Comply with Owner’s BIM requirements and BIM execution plan during construction. Develop and incorporate coordination drawing files into BIM established for Project.
   a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
   a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
   b. Digital Data Software Program: Drawings are available in Revit Version 2020.

c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner 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. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven 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 Contractor-generated RFIs will be returned without action:
    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. 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 by Architect 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 Section 012600 "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 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project management software. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number, including RFIs that were returned without action or withdrawn.
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.

F. 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.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Revit <Insert version of digital drawing software program and operating system>.
4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
    a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
5. The following digital data files will be furnished for each appropriate discipline:
    a. Floor plans.
    b. Reflected ceiling plans.

B. Web-Based Project Management Software Package: Use Owner's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:
    a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.

c. Document workflow planning, allowing customization of workflow between project entities.
d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Architect will 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 a minimum of seven days prior to meeting.
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 and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, 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. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long lead items.
e. Designation of key personnel and their duties.

f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Preparation of Record Documents.
p. Use of the premises.
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.

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

C. Sustainable Design Requirements Coordination Conference: Not Used.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for 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, and Owner's Commissioning Authority 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. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.

o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. 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.

E. Project Closeout Conference: Contractor will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

F. Progress Meetings: Architect will conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority 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.
3. 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) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Status of sustainable design documentation.
        6) Deliveries.
        7) Off-site fabrication.
        8) Access.
        9) Site use.
        10) Temporary facilities and controls.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) Status of RFIs.
        16) Status of Proposal Requests.
        17) Pending changes.
        18) Status of Change Orders.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.
4. 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.

G. Coordination Meetings: Contractor will conduct Project coordination meetings at biweekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Deliveries.
        6) Off-site fabrication.
        7) Access.
        8) Site use.
        9) Temporary facilities and controls.
        10) Work hours.
        11) Hazards and risks.
        12) Progress cleaning.
        13) Quality and work standards.
        14) Status of RFIs.
        15) Proposal Requests.
        16) Change Orders.
        17) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 3200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's Construction Schedule.
   3. Construction schedule updating reports.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Unusual event reports.

B. Related Requirements:
   1. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
   2. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.3 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.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. Working electronic copy of schedule file.
   2. PDF file.

B. Startup construction schedule.
   1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
   3. Total Float Report: List of activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, 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.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Use scheduling component of Project management software package specified in Section 013100 "Project Management and Coordination," for current Windows operating system.

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final 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.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main 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. Temporary Facilities: Indicate start and completion dates for the following as applicable:
    a. Securing of approvals and permits required for performance of the Work.
    b. Temporary facilities.
    c. Construction of mock-ups, prototypes and samples.
    d. Owner interfaces and furnishing of items.
    e. Interfaces with Separate Contracts.
    f. Regulatory agency approvals.
    g. Punch list.
3. Procurement Activities: Include procurement process activities for the following long lead-time 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.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. 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.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. 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. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. 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.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Building flush-out.
   m. Startup and placement into final use and operation.
   n. Commissioning.
8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Temporary enclosure and space conditioning.
   c. Permanent space enclosure.
   d. Completion of mechanical installation.
   e. Completion of electrical installation.
   f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion**,** and the following interim milestones:
   1. Temporary enclosure and space conditioning.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
   1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

G. 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 Requests for Information.
   3. Rejected or unreturned submittals.
   4. Notations on returned submittals.
   5. Pending modifications affecting the Work and the Contract Time.

H. 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.

I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. 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.

1.7 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.8 GANTT-CHART SCHEDULE REQUIREMENTS

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 Work.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. 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.

1.9 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.

11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site 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.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 3300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013500 “Delegated Design Procedures” for coordinating and submitting delegated design requirements.
5. section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
10. Section 018113.14 "Sustainable Design Requirements - LEED v4 BD+C" for sustainable design submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

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. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list 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 revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, 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 Architect's 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 15 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 15 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: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. 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 unsuitable 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 that show 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 Shop Drawings, and before or concurrently with Samples.

B. 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.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 36 by 48 inches.
3. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
7. 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.
8. 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 three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
    1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
    2. Manufacturer and product name, and model number if applicable.
    3. Number and name of room or space.
    4. Location within room or space.

E. 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.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. 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.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. 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.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that 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.
6. 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. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

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

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM Incorporation: Owner will incorporate delegated-design drawing and data files into BIM established for Project.

1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.9 CONTRACTOR'S REVIEW

A. Action Submittals 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. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp and indication in web-based Project management software. Include 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.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

B. Informational Submittals: Architect 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.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013500

DELEGATED DESIGN PROCEDURES

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

A. The provisions in this Section shall apply to all Sections of the Specifications within this Project Manual that include Delegated Design requirements. All Contract Documents, including General and Supplementary Conditions, Drawings, and Divisions 01 Specification Sections apply and are made part of this Specification Section.

B. RELATED SECTIONS: Includes, without limitation, the following:
   a. Division 01 Section, “Submittal Procedures”
   b. Division 01 Section, “Quality Control”

1.2 DEFINITIONS

A. Delegated Design:
   a. Delegated Design is professional design services or certifications by design professionals pertaining to permanent project Work delegated to the Contractor by the CONTRACT AND GENERAL CONDITIONS and these Specifications.
   b. The Contractor shall coordinate and assume or assign responsibility for design, engineering, calculations, permitting, submittals, fabrication, transportation, and installation.

B. Delegated Design Components: Complete systems that perform their intended functions.

C. Permit Authority: All authorities having local jurisdiction.

D. Owner's Design Professional, Architect or Engineer of Record or their consulting engineer.

E. Seal: Certification that drawings, computations and specifications were designed and prepared under direct supervision of a licensed Architect or Professional Engineer whose name appears thereon. Each seal shall be signed by the licensed design professional and dated.

F. Delegated Design Component Review Stamp: Certification that Delegated Design drawings, computations and specifications have been reviewed for compatibility with design intent and the Contract Documents.

1.3 CONTRACT REQUIREMENTS

A. When Delegated Design is required, the Contract Documents may specify some requirements, including, without limitation, performance requirements, design intent, appearance requirements, minimum requirements and other requirements.

B. Minimum Indicated Requirements: Provide specified minimum requirements even if the Delegated Design determines that a lower requirement will satisfy indicated Contract requirements.

1.4 RESPONSIBILITIES

A. Contractor's Responsibilities: With respect to each Delegated Design provision in any Section, the Contractor understands unequivocally that it is the Contractor's responsibility to provide an appropriately experienced, qualified, licensed, and registered design professional to perform the design services necessary to provide the design delegated to the Contractor.
    a. It is the Contractor's responsibility to coordinate and assume or assign complete responsibility for the design, calculations, submittals, fabrication, transportation, and installation of the Delegated Design portions or components as required in this Section.
    b. The Contractor is responsible for submitting to the Permit Authority all Delegated Design documents required for the separate approval for each Delegated Design item, if required by Permit Authority in a manner that will not adversely affect Project's construction schedule.
    c. Delegated Design components of this Work are defined as complete, operational systems, provided for their intended use.
    d. Because the Contractor is solely responsible for Coordination and the Project Schedule, the Owner shall not be responsible for paying for any delays, additional materials or products, additional hours of Work, or overtime, restocking or rework required due to failure by the Contractor or the subcontractor to coordinate their Work with the Work of other trades on the project or to provide the Delegated Design portion or component in a timely manner to meet the schedule of the project.
        i. Schedule design process and submittals required for Delegated Design portions to comply with the Project Construction Schedule.
        ii. Allow sufficient time for Architect's review of Delegated Design submittals. Provide time estimate and coordination of schedule for review of Delegated Design submittals to Contractor
    e. Because Delegated Design is the responsibility of the Contractor, the Contractor is to provide all resulting Work and materials required for the Delegated Design as part of the Contract Sum, and Contract Time.
    f. Coordinate contents requiring Delegated Design with adjacent, interfacing or related systems whether designed by the Architect, Engineer of Record or others, or are Delegated Design components. Ensure complete, operational systems that perform their intended use are provided.
    g. Engineer components of the Work requiring Delegated Design for wind, gravity, lateral and seismic loads and include design for life safety, sizing of supports, anchors, framing, connections, spacs and other characteristics required to meet or exceed requirements of applicable codes, standards, regulations, Permit Authorities, and design requirements of the Contract Documents.
        i. Refer to Structural Drawings for load criteria. If load criteria is not indicated on the Structural Drawings, request criteria from Architect.
    h. Ensure that the Delegated Design executes design intent as indicated in the Contract Documents.

B. DELEGATED DESIGNER'S RESPONSIBILITY
    a. Minimum qualifications for each approved design professional selected by the Contractor, the Delegated Designer, include the following and may also be specified in the applicable Section.
        i. Pennsylvania Licensed / Registered [discipline as applicable to scope of Delegated Design].
        ii. Minimum five (5) years and five (5) similar projects of experience for both Delegated Designer firm and individual Delegated Designer in responsible charge of design.
        iii. Minimum Professional Liability insurance: ($1,000,000) per claim and ($3,000,000) annual aggregate.
    b. The Delegated Designer shall be solely responsible for the design's compliance with contractually required performance standards, design criteria, applicable codes, other public law requirements and sound professional practice standards, unless Contract Documents

require a different or higher performance standard.

c. The Contractor and Delegated Designer shall be solely responsible for the Delegated Design's integration and coordination with the balance of the Contract Documents, as well as constructability issues with respect to the Work subject to the Delegated Design. The Owner and Owner's Design Professional shall not be responsible for paying for any delays, additional product, materials, hours or Work due to failure to Contractor or Delegated Designer to properly integrate and coordinate the Work.
d. If the Delegated Designer determines or believes the performance standards or design criteria are not clear, the Delegated Designer shall submit a written request for clarification to the Owner or the Owner's Design Professional.
e. The Delegated Designer shall be solely responsible for reviewing submittals from the Contractor or the Contractor's subcontractors with respect to Work within the scope of the Delegated Design and for the submittals' compliance with the Delegated Design requirements and compliance with contractually required performance standards, design criteria, applicable codes, other public law requirements and sound professional practice standards if prepared by others.
f. The Delegated Designer shall prepare and sign and seal all drawings, calculations, specifications, certifications, shop drawings and other submittals prepared by such professional.
g. The Delegated Designer shall issue a certificate in the following form, as may be adjusted to reflect the specific discipline of the delegated design:

   "The submitted design satisfies contractually-required performance standards or design criteria, applicable codes and sound professional practice standards and the undersigned designer understands and acknowledges that he/she is exclusively and professionally responsible for the design notwithstanding design review, collaboration, or other role or participation of the Owner's Design Professional or others in the design development and review process; and that the Owner and such others are entitled to rely upon the accuracy, completeness, reliability, quality, suitability, and constructability of the design and further rely upon the terms of the certification and the undersigned designer's representation that it has satisfied all contractual and professional practice, code and other public law requirements in the development of the design."

h. The Delegated Designer shall periodically perform field reviews of Delegated Design Work, including the review of associated mock-ups where applicable, at locations where the Work is in progress, fabrication and installation of Delegated Design Work, and provide submission of field review reports after each visit to Owner's Design Professional or Permit Authority as required.
   i. Provide field reviews at intervals as necessary and appropriate to progress of the Work related to Delegated Design components and determine if Work related to Delegated Design components is proceeding in general conformity with Contract Documents, including reviewed shop drawings and design calculations.
   ii. Include costs for field reviews, field reports and letters of general conformity in Contract Sum.
   iii. Upon completion of Delegated Design components of the Work, prepare and submit to Owner's Design Professional and Permit Authority as required, certifying general conformity for Delegated Design components of the Work, certifying that they have been supplied and installed in accordance with the requirements of the Contract Documents and Permit Authority.
   iv. Field Review Reports: Submit certified reports within three (3) days of Field Review, which include, at a minimum, the following:
      1. Dates: Date of Field Review, Date of Report issuance.

2. Project Identification: Name and contact information for the Owner, Architect, Contractor, Project and associated project numbers.
3. Delegated Designer: Name and contact information.
4. Record of temperature and weather conditions at time of Field Review.
5. Evaluation on whether reviewed Work complies with Delegated Design.
6. Photographs of the Work. Include overall and detail views with description and location of each image.
7. Names and contact information of individuals performing Field Review.
8. Detailed description of the Work at the time of Field Review.

C. ARCHITECT'S RESPONSIBILITY
   a. Any review, collaboration, or other role or participation in connection with the Delegated Design by the Owner, the Owner's Design Professional, or any consultant to either entity shall not relieve the Delegated Designer of it's sole professional responsibility as stated herein.
   b. Any Delegated Design submittal review by the Owner's Design Professional is limited to evaluating compliance with performance standards and/or design criteria set forth in the applicable specification and the Contract Documents. Such review does not affect the Contractor's or the Delegated Designer's exclusive responsibility for the adequacy, completeness, suitability, reliability, conformity, and compliance with the contractually required performance standards, design criteria, applicable codes, other public law requirements and sound professional practice standards.
   c. The Architect's review of Delegated Design submittals shall be solely for the purpose of evaluating compliance with performance specifications and design intent and shall not shift the responsibility from the Contractor, the Delegated Designer or the assigned subcontractor to the Owner or to the Architect.
   d. The Architect and Owner shall rely on the completeness of the services, certifications and approvals performed or provided by the Delegated Design professional.

1.5 SUBMITTAL PROCEDURES FOR DELEGATED DESIGN COMPONENTS
A. Comply with Division 01 Section "Submittal Procedures"
B. Affix a fully complete Division 00 Section "DELEGATED DESIGN SUBMITTAL FORM" to each submittal.
C. The intent of the Submittals required by this Section is to provide for professional responsibility for design, review and acceptance of components of the Work forming a part of the permanent Work in accordance with contractually required performance standards, design criteria, applicable codes, the Building Code, other public law and sound professional standards, that has been assigned to a qualified, licensed, registered design professional, the Delegated Designer.
D. This Section provides a standard form Letter of Commitment and a standard form Certificate, both of which should be adjusted to reflect the specific discipline and applicable Specification. The Letter of Commitment and Certificate are required to be signed and sealed by the Delegated Designer for all Delegated Design Work.
E. Preliminary Design: Submit to Architect sketches and product data describing Delegated Designer's design prior to performing engineering calculations and shop drawings.
   a. The purpose of the Preliminary Design submission is to avoid engineering and detailing an unacceptable design.
F. Prior to Work proceeding, including fabrication, complete the following:
   a. Submit complete, legible documents for Delegated Design components.
   b. Architect and Permit Authority, as appropriate, accept Delegated Design documents.
G. Submit permit submittal to Architect for review prior to submitting to Permit Authority
   a. Architect will review and return to contractor for submittal to Permit Authority after Architect's review stamp reads "Approved" or "Approved as Noted".
   b. Delegated Design permit submittal is in addition to product data, shop drawing and sample submittals required for construction.

H. Design and Calculations: Engineer's seal and calculations are required for that portion of Work by engineer licensed to practice in the jurisdiction of this project's location.
    a. Submittals without required calculations, without the Delegated Design Engineer's seal, or which have not been reviewed by Contractor will not be reviewed by Architect or Engineer of Record.
I. Letter: Commitment Letter and Certificate at the end of this section.
J. Field Reports: Portable Document Format (PDF)
K. Delegated Design Submittals: Indicate design criteria, design assumptions, unless noted otherwise in the specific Specification Section.
L. Delegated Design Shop Drawings: Show, without limitation, the following.
    a. Illustrate fully requirements of Contract Documents
    b. Correlate Shop Drawings detail references to Contract Document detail references
    c. Use Architect's keynote / naming convention in submittal
    d. Identify products, materials and equipment
    e. Show methods of assembly, layout, dimensions, connections and other data required for fabrication, coordination and installation.
    f. Show member sizes, loads, reactions, connections / anchors, dimensioned to column grid.
    g. Show context, building structure, column grid lines and interfacing portions of the Work.
    h. Provide large-scale drawings for fabrication of each item.
    i. Provide installation templates for Work installed by other trades.
    j. Take measurements in the field and verify all dimensions before submitting
    k. Include plans, elevations, sections, details
    l. Clearly indicate HSS [tube and pipe] seam locations
    m. Reproductions of Contract Documents are not acceptable as Shop Drawings
    n. Make notations of substitutions or deviations from requirements of Contract Documents in conspicuous manner on submittals.
M. Additional Submittal Requirements: Comply with individual specification section requirements.
N. Qualification Data: For qualified licensed Engineer
O. Delegated Design Conference: Meeting Minutes, if conference is required in other Sections with Delegated Design components.

1.6 QUALITY ASSURANCE
A. In addition to requirements specified herein, comply with Quality Assurance requirements specified in other Sections with Delegated Design components.
B. Documentation: Comply with the following:
    a. Uniform Drawing System
    b. Minimum Text Size: 1/8 inch
    c. Legible when microfilmed
    d. Other requirements by Permit Authority
    e. Drawings are to be professionally drawn and domestically produced.
C. Design Requirements: Refer to requirements within individual specification sections.
D. Permit Authority Requirements:
    1. Comply with Permit Authority policies regarding Delegated Design components of building projects.
    2. Delegated Design Drawings: Design drawings clearly and legibly showing all members, dimensions, connections, materials used, and indicating how the part is attached to the main structure. Confirm with permitting agency for required number of permit review sets required.
        a. Drawings shall be prepared, designed, and sealed by an Engineer licensed to practice in the jurisdiction of this project's location.
        b. Drawings shall be signed indicating General Design Conformance by Architect or Engineer of Record.
        c. Shop drawings or erection drawings are not acceptable as Delegated Design drawings.
    3. Delegated Design Calculations: Provide, at a minimum, the following criteria, design

assumptions, substantiating computations, and such additional data sufficient to show the correctness of the Delegated Design and compliance with the structural provisions of the Building Code. Confirm with permitting agency for required number of calculation sets required.
   a. Calculations shall be prepared and sealed by the Delegated Design Engineer who prepared and sealed the drawings.
   b. Calculations shall be signed by the Architect or Engineer of Record indicating acceptance of design concepts, loading criteria, and compatibility of designs.
4. Submit a Contractor Design Summary Sheet (when required by Permit Authority) listing Delegated Design subcontractors and their registered Delegated Designer's name and phone number prior to permit issuance.

1.7 SUBSTITUTIONS
A. Items Required to be Submitted as a Substitution: Any construction / assemblies engineered by the Contractor which deviates from Contract Document requirements
B. Substitution Requirements: Comply with all procedures and requirements specified in Division 01 Section "Substitutions"
C. Notwithstanding any other provisions, the Delegated Designer has reasonable discretion to substitute if the substitution complies with the performance specifications and design intent.

1.8 PERFORMANCE & DESIGN CRITERIA REQUIREMENTS
A. Provide products and systems complying with specific performance and design criteria indicated where professional design services or certifications by a design professional are specifically required of Contractor by Contract Documents.
B. If design criteria indicated is insufficient to perform services or certification required, submit a written request for additional information to the Owner or Owner's Design Professional.
C. Delegated Design submittals are not required for components of Work requiring engineering for temporary Work (for example: crane hoisting, engineered lifts, false work, shoring, concrete formwork) that would normally form a part of the Contractor's scope of Work.

1.9 DELEGATED DESIGN CONFERENCE
A. Conduct conference when conference is required in other Sections with Delegated Design components.
B. Agenda: At a minimum, include the following:
   a. Review Delegated Design General Provisions Specification Section
   b. Review Specification Sections requiring Delegated Design
   c. Review related Contract Documents, including drawings
   d. Schedule: Project, submittals, fabrication and installation time.
   e. Coordination: Review interfaces with other Work. If conflicts are identified, develop corrective action.
C. Meeting Participants: At a minimum, include the following:
   a. Architect
   b. Contractor
   c. Delegated Designer
   d. Subcontractor / fabricator / installer of Work
   e. Subcontractor / fabricator / installers of interfacing Work.
D. Meeting Chair: Architect
E. Meeting Minutes: By Contractor. Distribute to Meeting Participants within 2 days after meeting.
F. Schedule Meeting: Contractor schedules meeting after coordination with Architect's schedule. Schedule meeting after Delegated Designer is hired by Contractor, and before start of their Work.
G. Schedule Meeting Notification: At least 2 days before meeting.
H. Any review, collaboration or other role or participation in connection with the Delegated Design by the Owner or Architect shall not relieve the Delegated Designer of it's sole professional responsibility for the design.

PART 2: PRODUCTS

2.1 COMMITMENT LETTER

A. Submit a signed and sealed Commitment Letter on company letterhead addressed to the Architect, in accordance with format in Appendix A attached to the end of this Section prior to starting Work requiring design and seal of a professional engineer.

2.2 CERTIFICATE

A. Submit a signed and sealed Certificate on company letterhead addressed to Architect, in accordance with format in Appendix B attached to the end of this Section on completion of Work requiring design and seal of the Designated Designer.

PART 3: EXECUTION

3.1 IMPLEMENTATION

A. Include summary of Work described in technical specification section as a part of the required Letter of Commitment.

B. Prepare required submittals and present to Architect within sufficient time to allow for Architect's review for compliance with the performance specifications and/or design criteria without delay in project schedule.

3.2 SCHEDULING AND COORDINATION

A. Comply with Permit Authority requirements current at time of submission.

B. Submit material required by Permit Authority so that Permit Authority's review will not adversely affect construction schedule.

   a. Prior to submittal, meet with Permit Authority to identify Delegated Design components and review submittal requirements.

C. Complete submission of Delegated Design documents prior to issuance of the building permit, when required by Permit Authority.

   a. Permit for Delegated Design must be issued and paid for prior to fabrication.

D. Owner will not be responsible for paying for any delays, additional products, additional hours of Work, overtime, restocking or rework required due to failure by the Contractor to coordinate Delegated Design Work or to execute Delegated Design Work in a timely manner.

3.3 DELEGATED DESIGN SCHEDULE: Sections with Delegated Design components include but are not limited to the following:

1. Section 04 2000 - Unit Masonry: Anchors and Ties
2. Section 04 4313.13 - Anchored Stone Veneer
3. Section 04 7200 - Cast Stone Masonry
4. Section 05 1200 - Structural Steel
5. Section 05 4000 - Cold Formed Metal Framing
6. Section 05 5000 - Metal Fabrication
7. Section 05 5113 - Metal Pan Stairs
8. Section 05 5213 - Pipe and Tube Railings
9. Section 05 7300 - Decorative Metal Railings and Infill Panels
10. Section 07 4213.13 - Formed Metal Wall Panels
11. Section 07 5323 - Ethylene-Propylene-Diene-monomer (EPDM) Roofing
12. Section 07 8413 - Penetration Firestopping (engineer's judgements)
13. Section 07 8443 - Joint Firestopping (engineer's judgements)
14. Section 08 4113 - Aluminum-Framed Entrances & Storefronta
15. Section 08 4313 - Glazed Aluminum Curtain Walls
16. Section 08 8000 - Glazing

17. Section 11 0140 - Tieback and Lifeline Anchors
18. Division 21 - Fire Suppression
19. Division 22 - Plumbing
20. Division 23 - HVAC
21. Division 26 - Electrical
22. Division 27 - Communications
23. Division 31 - Earthwork
24. Division 32 - Exterior Improvements

APPENDIX A

1.1 LETTER OF COMMITMENT

A: Submit a signed and sealed letter of commitment on company letterhead in the form as follows:

[Date]

[Address]

Re: Letter of Commitment for Delegated Designer of [System of Component of Work]

[Name of Project]
[Project Number]
[City, State, Zip Code]

As the retained registered professional engineer for design and field review of the above named component of Work and project, I hereby certify I am qualified, licensed and registered in Rhode Island to perform the following Work as required by Contract Documents. I will perform the Delegated Design in accordance with contractually required performance standards, design criteria, applicable codes, the Building Code, other public law and some professional standards.

I hereby certify that I will be responsible for above noted Work as described in Section [?????] – [Name of Section] of Project Manual, including requirements of addenda, change orders and change directives.

I shall also be responsible for field review of fabrication and erection of components as required to achieve substantial compliance with the Building Code and Contract Documents.

I will notify you in writing if my responsibility is terminated at any time during the course of Work covered by this Letter of Commitment.

Retained Professional Engineer Name [type written]
Retained Professional Engineer's Signature
Date

(Apply seal)

APPENDIX B

Certificate

Submit a signed and sealed Certificate in the following format on company letterhead, adjusted to reflect the discipline of the Delegated Designer of [System of Component of Work].

Certificate

The submitted design for _____ satisfies contractually-required performance standards or design criteria, applicable codes and sound professional practice standards and the undersigned designer understands and acknowledges that he/she is exclusively and professionally responsible for the design notwithstanding design review, collaboration, or other role or participation by the Owner's Design Professional or others in the design development and review process; and that the Owner and such others are entitled to rely upon the accuracy, completeness, reliability, quality, suitability, and constructability of the design and further rely upon the terms of this certification and the undersigned designer's representation that it has satisfied all contractual and professional practice, code and other public law requirements in the development of the design.

Retained Professional Engineer Name
Retained Professional Engineer Signature
Date:
(Apply Seal)

END OF SECTION

SECTION 01 3500.1

DELEGATED DESIGN SUBMITTAL FORM

This 2-page Submittal Form is to be FULLY completed by the Constructor and attached to **ALL** submittals for this Project.
Use additional sheets as needed. Attach supporting / substantiating documentation to this form. Modifications to form: Prohibited.

PART A: GENERAL SUBMITTAL INFORMATION:
CONSTRUCTOR:_____
name
address, line 1
A/E:_____
address, line 2

NUMBER:_____
A.1: OWNER'S DESIGN PROFESSIONAL:
Weber Murphy Fox, Inc.
_____

A.2: CONSTRUCTOR:
NUMBER:_____
<< constructor name >>
<< constructor address, line 1 >>
NUMBER:_____
<< constructor address, line 2 >>

NUMBER(s):_____
A.3: DELEGATED DESIGN ENGINEER
Contact Information
NUMBER(s):_____

Engineer's Name: _____

Company Name: _____
_____

Address: _____

Phone Number: _____

A.5: DATE SUBMITTED TO

A.6: DATE SUBMITTED TO

A.7: SUBMITTAL

A.8: RESUBMITTAL NUMBER: R-___

A.9: SPECIFICATION SECTION REFERENCE:_____

A.10: SPECIFICATION PAGE

A.11: SPECIFICATION ARTICLE

A.12: DRAWING SHEET

A.13 DETAIL SHEET

A.14: STANDARDS REFERENCES (ANSI, ASTM, FS, etc.)

_____

_____

A.15 ATTACHMENTS: Label each page with Submittal

A.15.1 ☐ Drawings A15.2 ☐ Reports A15.3 ☐ Calculations A15.4 ☐ Schedules

A.15.5: Deviation from Contract Documents? ☐ NO Deviations ☐ YES (attach complete documentation)

B: COORDINATION IS REQUIRED WITH WORK IN THESE DIVISIONS (Constructor mark all that apply)

☐ 02 ☐ 03 ☐ 04 ☐ 05 ☐ 06 ☐ 07 ☐ 08 ☐ 09 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14

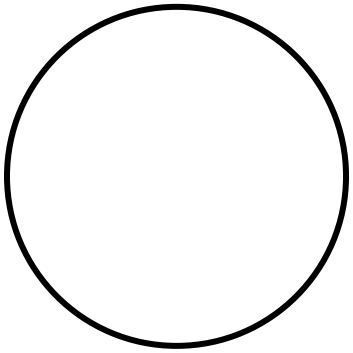
☐ 21 ☐ 22 ☐ 23 ☐ 25 ☐ 26 ☐ 27 ☐ 28 ☐ 31 ☐ 32 ☐ 33

C: CONSTRUCTOR REVIEW CERTIFICATION: Constructor is responsible for providing submittals which are approvable. As an authorized agent of the Constructor, I hereby certify that the attached submittal has been reviewed and as revisions marked, is in complete compliance with the Contract Documents.

C.1: Reviewer Signature: _____

C.2: Printed Name: _____ Date Signed:_____

D: DELEGATED DESIGNER'S CERTIFICATION: (Completed by the Delegated Designer)
The submitted design satisfies contractually-required performance standards or design criteria, applicable codes and sound professional practice standards and the undersigned designer understands and acknowledges that he/she is exclusively and professionally responsible for design notwithstanding design review, collaboration, or other role or participation of the Owner's Design Professional or others in the design development and review process; and that the Owner and such others are entitled to rely upon the accuracy, completeness, reliability, quality, suitability, and constructability of the design and further rely upon the terms of the certification and the undersigned designer's representation that it has satisfied all contractual and professional practice, code and other public law requirements in the development of the design.



D.1: Reviewer Signature: _____

D.2: Printed Name:_____ Date Signed:_____

⇐ Affix Delegated Designer's professional stamp, sign and date in the space provided

E: SUBMITTAL REVIEW ACTION

E.1: OWNER'S DESIGN PROFESSIONAL REVIEW STAMP: (Completed by Owner's Design Professional)
Reviewed for General Conformance with the design concept of the Work as set forth in the Contract Documents. Neither this submittal review by the Owner's Design Professional nor any participation in reviews or comments with respect to preliminary or iterative designs shall in any manner or respect diminish or otherwise affect the Contractor's and its Delegated Designer's exclusive responsibility for the adequacy, completeness, suitability, reliability, conformity and compliance of the design with requirements of the Contract Documents, applicable codes and standards, and applicable professional practice standards. Corrections and comments made or not made on this submittal do not relieve the contractor from compliance with the Contract Documents. Refer to the Contract Documents for Contractor's Responsibilities.

- ☐ APPROVED
- ☐ APPROVED AS NOTED – PROCEED
- ☐ REVISE AND RESUBMIT
- ☐ NO ACTION TAKEN OR REQUIRED

E.2: OWNER'S DESIGN PROFESSIONAL'S CONSULTANT REVIEW STAMP (Completed by Owner's Design Professional's Consultant)

☐ REJECTED – DO NOT USE

E.2: COMMENTS _____
_____

_____
_____

_____
_____

Reviewer: _____ Date: _____

E.4: COMMENTS

Reviewer: _____ Date: _____

☐ Additional comments as attached.

- END OF FORM –

WEBER MURPHY FOX
ELECTRONIC BIDDING DOCUMENTS TERMS OF USE

PROJECT:	
RECIPIENT:	
DATE:	
LISTING OF ELECTRONIC BIDDING DOCUMENTS PROVIDED:	
SOFTWARE AND VERSION:	

TERMS OF USE

WEBER MURPHY FOX (WMF) grants the RECIPIENT a non-exclusive license to use the ELECTRONIC BIDDING DOCUMENTS in connection with the Project. The RECIPIENT may not transfer the ELECTRONIC BIDDING DOCUMENTS to a third party except to the RECIPIENT's sub-bidders and suppliers. The RECIPIENT may not use the ELECTRONIC BIDDING DOCUMENTS in connection with any other project without the prior WRITTEN PERMISSION of WMF. The ELECTRONIC BIDDING DOCUMENTS are transmitted to the RECIPIENT to assist in their preparation of a bid for the Project. Possession of the ELECTRONIC BIDDING DOCUMENTS does not confer any license or right to the RECIPIENT to use any of the software, methods, trade secrets, design patents and/or unpublished works used in creating the ELECTRONIC BIDDING DOCUMENTS.

The sealed documents, including any modifications, revisions, clarifications, changes and/or addenda or bulletins issued in connection with the Project shall be considered superior to the ELECTRONIC BIDDING DOCUMENTS. RECIPIENT may review these documents at the offices of WMF and may purchase a copy for the cost of reproduction. WMF, its consultants and/or its suppliers, in their sole discretion, may change the underlying project information without any obligation to notify the RECIPIENT except as provided in the Project Manual. The RECIPIENT shall be solely responsible for coordination with any changes.

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RECIPIENT:	
SIGNATURE:	
DATE:	

SECTION 01 4000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Testing and inspection 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. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five 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.

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

C. 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, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:
    a. Verify selections made under Sample submittals.
    b. Demonstrate aesthetic effects.
    c. Demonstrate the qualities of products and workmanship.
    d. Demonstrate successful installation of interfaces between components and systems.
    e. Perform preconstruction testing to determine system performance.
2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.

3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. 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.

J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED DESIGN SERVICES

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

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

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is 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.

1.6 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. 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.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, 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.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 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, telephone number, and email address 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 inspection.
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 Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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, applying, 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 is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical 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. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. 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 Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, 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.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
    a. Allow seven days for initial review and each re-review of each mockup.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Specialty Mockups: See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups and room mockups.

1.11 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.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection 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, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.
    a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. 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.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations 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 duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives 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 inspection. 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 inspection equipment at Project site.

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

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

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

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, Commissioning Authority, 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 and Commissioning Authority, 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 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, 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 Section 017300 "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

SECTION 01 4200

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

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.

1.3 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.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

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.

1.4 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 Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

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. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

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. Information is subject to change and is up to date as of the date of the Contract Documents.

1. DOE - Department of Energy; www.energy.gov.
2. EPA - Environmental Protection Agency; www.epa.gov.
3. FG - Federal Government Publications; www.gpo.gov/fdsys.
4. GSA - General Services Administration; www.gsa.gov.
5. OSHA - Occupational Safety & Health Administration; www.osha.gov.
6. SD - Department of State; www.state.gov.
7. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
8. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
9. USPS - United States Postal Service; www.usps.com.

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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.govinfo.gov.
2. DLA Document Services; www.quicksearch.dla.mil.
3. FED-STD - Federal Standard; (See FS).
4. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
5. USAB - United States Access Board; www.access-board.gov.
6. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 4339

MOCKUPS

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. Related Requirements:
   1. Section 01 3500 “Delegated Design Procedures” for any contractor engineering and testing.
   2. Section 01 4000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior mockups.
   2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
   3. Review locations and extent of mockups.
   4. Review testing procedures to be performed on mockups.
   5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For exterior, free standing mockups as shown on drawing A0-31.
   1. Include plans, elevations, sections, and details
   2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
   3. Include site location drawing indicating orientation of mockup.
   4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.

B. Build mockups to do the following:
   1. Verify selections made under Sample submittals.
   2. Demonstrate aesthetic effects.
   3. Demonstrate the qualities of products and workmanship.
   4. Demonstrate acceptable coordination between components and systems.
   5. Perform preconstruction testing, such as window air- and water-infiltration testing.

C. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated. All engineering of freestanding mock-ups are to be delegated design, reference 01 3500 “Delegated Design Procedures” for requirements.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

D. Notifications:

1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Notify Architect 14 days in advance of the dates and times when mockups will be tested.
3. Allow seven days for initial review and each re-review of each mockup.

E. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

SECTION 01 4519

AIR BARRIER QUALITY CONTROL

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. This section includes administrative and procedural requirements for accomplishing an airtight building enclosure that controls infiltration or exfiltration of air.

1. The airtight components of the building enclosure and the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the building enclosure are called “the air barrier system”. Services include coordination between the trades, the proper scheduling and sequencing of the work, preconstruction meetings, inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.

2. The Contractor shall ensure that the intent of constructing the building enclosure with a continuous air barrier system to control air leakage into, or out of the conditioned and semi-conditioned space is achieved. The air barrier system shall have the following characteristics:

a. It must be continuous, with all joints sealed.

b. It must be structurally supported to withstand positive and negative air pressures applied to the building enclosure.

c. Connection shall be made between:

1) Foundation and walls.

2) Walls and windows or doors.

3) Different wall systems.

4) Wall and roof.

5) Wall and floor over unconditioned space.

6) Walls and floors between conditioned and semi-conditioned or unconditioned space

7) Walls, floor and roof across construction, control and expansion joints.

8) Walls, floors and roof to utility, pipe and duct penetrations.

3. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made air-tight.

B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

C. Requirements of this section relate to the coordination between subcontractors required to provide an airtight building enclosure, customized fabrication and installation procedures, not production of standard products.

1. Continuity of the air barrier materials and products with joints to provide assemblies. Continuity of all the enclosure assemblies with joints and transition materials to provide a whole building air barrier system.

2. Specific quality-control requirements for individual construction activities are specified in the sections of the specifications. Requirements in those sections may also cover production of standard products. It is the Contractor's responsibility to ensure that each subcontractor is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each section.

3. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.

4. Requirements for Contractor to provide an airtight building enclosure is not limited by quality-control services required by Architect, Owner, or authorities having jurisdiction and are not limited by provisions of this section.

1.4 RELATED SECTIONS

A. The requirements of this section apply to all materials, systems, and assemblies that integrate and make up the complete and continuous air barrier system for the building enclosure. These are specified in related sections of this manual and include but are not limited to:

1. 07 2713 Modified Bituminous Sheet Air Barriers
2. 07 5323 EDPM Roofing
3. 07 6200 Sheet Metal Flashing and Trim
4. 07 7200 Roof Accessories
5. 07 8413 Penetration Firestopping
6. 08 1113 Hollow Metal Doors and Frames
7. 08 4413 Glazed Aluminum Curtain Walls
8. 08 8000 Glazing

1.5 RESPONSIBILITIES

A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide coordination of the trades, and the sequence of construction to ensure continuity of the air barrier system joints, junctures and transitions between materials and assemblies of materials and products, from substructure to walls to roof. Provide quality assurance procedures, testing and verification as specified herein. Facilitate inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction or by the Owner. Costs for these services are included in the Contract Sum.

1. Organize preconstruction meetings between the trades involved in the whole building's air barrier system to discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in the different sections, to be installed by the different trades.
2. Provide coordination drawings of all the joints and junctures between the different trades, products and systems that make up the enclosure of the conditioned or semi-conditioned and unconditioned space in the building.
3. Build a mock-up before proceeding with the work, satisfactory to the Architect, of each air-tight joint type, juncture, and transition between products, materials and assemblies.

B. Associated Services: Cooperate with agencies performing commissioning, required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:

1. Provide access to the Work.
2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
4. Deliver samples to testing laboratories.
5. Provide security and protection of samples and test equipment at the Project Site.

C. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.6 PERFORMANCE REQUIREMENTS

A. Compliance Requirements:

1. Materials: materials used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft^2 under a pressure differential

of 0.3 in. water (1.57psf) (0.02 L/s.m2 @ 75 Pa) when tested in accordance with ASTM E 2178. And,

2. Assemblies of materials and components: shall have an air permeance not to exceed 0.04 cfm/ ft^2 under a pressure differential of 0.3 in. water (1.57psf) (0.15 L/s.m2 @ 75 Pa) when tested in accordance with ASTM E 2357. And,

3. The entire building: The air leakage of the entire building shall not exceed 0.05 cfm/ft^2 under a pressure differential of 0.3 in. water (1.57psf) (0.75 L/s.m2 @ 75 Pa) when tested according to the US Army Corps of Engineers test protocol and ASTM E 779.

1.7 SUBMITTALS

A. The Contractor shall provide evidence of meeting the material and assembly performance requirements above. The Contractor shall engage a testing agency to test the whole building with completed air barrier to meet the performance requirements specified herein, and other substantiation testing required. The independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect through the Contractor.

1. Submit for approval the qualifications and experience of the testing entity showing the experience of the agency in performing the required tests on similar large buildings.

2. Submit for approval a test protocol specific to the project following the US Army Corps of Engineers (USACE) test protocol for testing large buildings; the protocol shall describe the preparation of the building for testing.

3. Submit for approval a diagram tracing continuity of the air barrier in building sections and plans, providing area calculations of the pressure boundary.

4. Report Data: Provide test reports in accordance with the USACE test protocol requirements.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

3.2 TESTING AND INSPECTION

A. The Owner will engage the services of a commissioning agency to provide occasional observation and inspection during installation of the air barrier system and to witness required testing by the Contractor. The commissioning agency will provide the following listed services:

1. Qualitative Inspection:

a. Reports of observations, with copies to the Owner, Contractor and Architect.

b. Continuity of the air barrier system throughout the building enclosure with no gaps, holes.

c. Structural support of the air barrier system to withstand design air pressures.

d. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions and mortar droppings, with mortar joints struck flush, or as required by the manufacturer of the air barrier material.

e. Site conditions for application temperature and dryness of substrates.

f. Maximum length of exposure time of materials to ultra-violet deterioration.

g. Surfaces are properly primed.

h. Laps in material are 2” minimum, shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.

i. Mastic applied on cut edges.

j. Roller has been used to enhance adhesion of sheet applied air barrier membranes.

k. Treatment and reinforcement of joints between gypsum sheathing boards.

l. Measure application thickness of liquid-applied materials to manufacturer’s specifications for the specific substrate.

m. Materials used for compatibility.

n. Transitions at changes in direction, and structural support at gaps.

o. Connections between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.

p. All penetrations sealed.

2. Quantitative tests provided by the contractor and witnessed by the Building Enclosure Commissioning Provider:

a. Whole building airtightness test in accordance with USACE test protocol and ASTM E779, Determining Airtightness of Buildings Air Leakage Rate by Single Zone Air Pressurization.

b. Windows, curtain wall, and polycarbonate panel connections to adjacent opaque assemblies, ASTM E783 and ASTM E 1105

c. Bond to substrate, ASTM D4541 adhesion testing.

d. Minimum dry or wet film thickness for liquid-applied materials are per the

manufacturer’s requirements.

3. Required Substantiation:

   a. Demonstrate performance of the continuous air barrier for the building enclosure by the following tests:

      a) Test the completed building and demonstrate that the air leakage rate of the building enclosure does not exceed 0.05 cfm/ft^2 at a pressure differential of 0.3" w.g.(75 Pa) (0.75 L/s*m2 @ 75 Pa), in accordance with ASTM's E 779 (2010) and the USACE protocol. Accomplish tests using either pressurization or depressurization or both. Divide the volume of air flow in cfm @ 0.3" w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft2 @ 0.3" w.g. (L/s*m2 @ 75 Pa). Do not test the building until verifying that the continuous air barrier system has been installed and all known deficiencies have been addressed.

      b) Test the completed building using Infrared thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. While the building is pressurized/depressurized and non-pressurized. Identify air leakage pathways discovered during infrared thermography and insulation discontinuities. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060. Determine air leakage pathways using ASTM E 1186 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems smoke tracer, and perform corrective work as necessary to eliminate air leakage pathways, irrespective of achieving the whole building air leakage rate specified in (a) above.

END OF SECTION

SECTION 01 5000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Contractor will provide adequate portable toilets for all workers on site.

C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Contractor will pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Water Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

F. Gas Service: Contractor will establish temporary line from existing system to be coordinated with gas provider systems is available for use with metering and with payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Erosion and Sedimentation Control Plan: Show compliance with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

H. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

1.5 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 United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 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 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 15 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

2.3 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, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
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 Section 017700 "Closeout Procedures."

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 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 Section 011000 "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.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to private system indicated as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash 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. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

F. Temporary 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.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

1. The existing 208Y/120 volt, three phase, four wire service rated at 800 amps located in the boiler room of the existing building shall remain through construction. Existing service consists of an 800 amp main fusible switch section and an 800 amp rated fusible switch distribution section. This service shall be fed from the existing 225KVA pad mounted transformer that will be relocated as part of this project to temporarily refeed this service.

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Connect temporary service to Owner's existing power source, as directed by Owner.

I. 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.

J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line(s) for each field office.
1. At each telephone, post a list of important telephone numbers.
a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

K. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:
1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. 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 within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned 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 in accordance with Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

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: Use designated areas of Owner's existing parking areas for construction personnel.

F. Storage and Staging: Provide temporary offsite area or Use designated areas of Project site for storage and staging needs.

G. 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 or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. 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.
3. Maintain and touch up signs, so they are legible at all times.

I. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

J. 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 progress cleaning requirements in Section 017300 "Execution."

K. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

L. Temporary Elevator Use: Use of elevators is not permitted.

M. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

N. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. 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.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 311000 "Site Clearing."

D. 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 and requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

E. 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.

F. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

G. 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.

H. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

I. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations or As indicated on Drawings.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

J. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

K. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

L. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

M. 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 incomplete, insulate temporary enclosures.

N. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

O. 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; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with 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.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: 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. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: 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. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 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. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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 Requirements:

1. Section 01 1000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 01 2100 "Allowances" for products selected under an allowance.
3. Section 01 2300 "Alternates" for products selected under an alternate.
4. Section 01 2500 "Substitution Procedures" for requests for substitutions.
5. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 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. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, 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 single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 3300 "Submittal Procedures."

F. Substitution: Refer to Section 01 2500 "Substitution Procedures" for definition and limitations on substitutions.

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. Resolution of Compatibility Disputes between Multiple Contractors:

a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 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 that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to 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 in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 7700 "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 meeting 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.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole 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.
    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole 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.
    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: 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.
    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: 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.
    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: 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.
    a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: 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.
    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. 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 may additionally 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.
    a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "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 Section 01 2500 "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 a 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.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
    1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: 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 the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
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.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 3300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

FASTENER REQUIREMENTS

A. Fasteners: Includes bolts, chemical bolts, epoxy anchors, expansion bolts, nails, pins, powder actuated devices, screws, wedge bolts, and all other types of mechanical connections.

B. Fasteners Completely Specified: All aspects of the fastener are specified.

1. "Completely Specified": All aspects of the fastener type have been specified. This includes, without limitation: type, material, finish, size, diameter, length and spacing.

C. Fasteners Incompletely Specified: May occur in the Contract Documents. This provides the Contractor fastener type options and ability to control the means, methods and techniques of construction. When fasteners are incompletely specified, provide:

1. Fasteners appropriate for each unique condition, substrate, load, exposure and usage.
2. Size and Spacing: Use manufacturer's published recommendations and load tables.
3. Safety Factor: Five or greater.
4. Safety Factor, Working Load: ≤20 percent of ultimate load capacity.
5. Corrosion Resistance: Provide equal to or higher than items being fastened.
6. Fastener for Architect's Review: Required prior to use.
7. Compatibility: Ensure materials and fasteners are compatible
8. Head Type: As approved by Architect.
9. Undercut at Flush Alignments: Provide to maintain flush alignment at sheet metal applications.

D. Country of Manufacture: United States of America, except for those "Basis-of-Design" specified.

E. Bolts, Nuts, Washers: Matched, from same manufacturer.

F. Exposed to View Fasteners: Prohibited, except if preapproved by Architect.

G. Installation: Conform to manufacturer's recommendations

1. Driver Speed and Clutch: Adjust to comply with fastener manufacturer's recommendations.
2. Torque: Install each fastener with fastener manufacturer's recommended torque.
3. Impact Drivers: Prohibited.
4. Overdrive / Tightening: Prohibited
5. Exposed to View: If fastener is exposed to view, align head orientation alike
6. Damage to Head: Stripped, or otherwise, replace with undamaged fastener.
7. Damage to Threads: Stripped, or otherwise, replace with undamaged fastener.
8. Broken Fasteners: Prohibited. Do not break.
9. Framing: Locate prior to driving fasteners.
10. "Hunting" or "Searching" For Framing by Drilling Holes or Test Fasteners: Prohibited.

11. Driver Skipping Off Fastener, Damaging Surface: Prohibited.
12. Unnecessary Holes in Materials: Prohibited
13. Driving Fasteners: As shown, or if not shown, perpendicular to anchoring surface.
14. Fastener Head: Seat to bear uniformly
15. Fastener Finish: As shown, or if not shown, match surrounding surface color
16. Minimum Withdrawal Resistance: Achieve for each fastener.
17. Factory Provided Screw Hole: Provide fastener for each.
18. Fastener Quantity, Individual Items: As shown, or if not shown, at least two fasteners.
19. Metal Substrate: Drill and tap as appropriate.
20. Wood, Concrete: Provide pilot hole, as appropriate.
21. Fastener Inspection: Confirm every fastener is correctly installed.
    a. Unacceptable Fasteners: Those which do not comply with "Fastener Installation"
    b. Fasteners Which Miss Framing: Prohibited, and unacceptable.
    c. Fasteners Which Spin Freely and Cannot Be Torqued: Prohibited, and unacceptable.

H. Fasteners Requiring Pilot or Predrilled Holes:
1. Drill Bit Diameter: Use fastener manufacturer's coordinated and recommended bit diameter.
2. Drill Hole Depth: As recommended by fastener manufacturer.
3. Drill Hole Cleaning: Immediately before fastener installation.
4. Structural Capacity: Do not compromise with drill hole. Follow manufacturer's requirements and recommendations.

I. Fasteners within Delegated Design Assemblies: Provide fasteners indicated on approved engineered submittals.
1. Working Load Capacity: Install each fastener to achieve manufacturer's published capacity.
2. Working Load Capacity: Is not ultimate load capacity.
3. Torque: Each fastener within the minimum / maximum range recommended by fastener manufacturer.

J. Submittals: Comply with Section 013300 - Submittal Procedures. Provide the following submittals for each type of fastener used:
1. Product Data (load capacity, safety factor, recommendations, limitations, instructions)
2. Samples: Provide with finish associated driver bits.
3. Label each sample with intended usage, including recommended substrates.

K. Remedial Work for Unacceptable Fasteners:
1. Remove each unacceptable fastener.
2. Plug holes in substrate. At Gypsum Sheathing, use sealant.
3. Repair finish to comply with manufacturer’s repair recommendations.

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Recycling nonhazardous demolition construction waste.
   2. Disposing of nonhazardous demolition construction waste.

B. Construction waste management and recycling is required to meet LEED New Construction BD+C LEED v4 requirements.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

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.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (s*al*vaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. LEED Submittal: Submit documentation to USGBC, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Respond to questions and requests from USGBC regarding construction waste management and disposal until the USGBC has made its determination on the project's LEED certification application. Document correspondence with USGBC as informational submittals.

F. Qualification Data: For refrigerant recovery technician.

G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

H. Refrigerant Recovery: Comply with requirements in Section 024116 "Structure Demolition" for refrigerant recovery submittals.

I. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

J. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.

K. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 024116 "Structure Demolition."
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.

4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

a. Asphalt paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.
e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.

kk. Lamps.
ll. Ballasts.
mm. Electrical devices.
nn. Switchgear and panelboards.
oo. Transformers.

2. Construction Waste:
   a. Masonry and CMU.
   b. Lumber.
   c. Wood sheet materials.
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Carpet and pad.
   i. Gypsum board.
   j. Piping.
   k. Electrical conduit.
   l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
      6) Wood crates.
      7) Wood pallets.
      8) Plastic pails.
   m. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
      1) Paper.
      2) Aluminum cans.
      3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
   1. Distribute waste management plan to everyone concerned within three of submittal return.

2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Transportation equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by [12 inches] <Insert dimension> or more.

3.2 RECYCLING DEMOLITION CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until 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 the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.3 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inchsize.

1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inchsize.
2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 3/4-inch size.

a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill
b. Crush masonry and screen to comply with requirements in Section 329300 "Plants" for use as mineral mulch.

2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

J. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

K. Carpet: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

L. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

M. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

N. Conduit: Reduce conduit to straight lengths and store by material and size.

O. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.4 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. 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.

a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
    a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.5 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, 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. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

D. 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.

3.6 ATTACHMENTS

A. Form CWM-1 for construction waste identification.

B. Form CWM-2 for demolition waste identification.

C. Form CWM-3 for construction waste reduction work plan.

D. Form CWM-4 for demolition waste reduction work plan.

E. Form CWM-5 for cost/revenue analysis of construction waste reduction work plan.

F. Form CWM-6 for cost/revenue analysis of demolition waste reduction work plan.

G. Form CWM-7 for construction waste reduction progress report.

H. Form CWM-8 for demolition waste reduction progress report.

END OF SECTION

SECTION 01 7700

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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 Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

1.5 CLOSEOUT SUBMITTALS

A. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect Label with manufacturer's name and model number.
    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner’s signature for receipt of submittals.
5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. 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. 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.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. 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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to the Owner and by uploading to web-based project software site.

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-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.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.10 ARCHITECT INSPECTION REQUIREMENTS

A. Definitions:

1. Contractor's Punch List: Complete list of incomplete and incorrect Work prepared by the Contractor prior to request of Architect's inspection for Certification of Substantial Completion. As a minimum the List shall include the following information for each work item:
    a. Location identification organized by Building, Area, Room Number, or combination thereof as appropriate to project.
    b. Clear identification of each incomplete work item and non-conforming work items, including all subcontractor's work.
    c. Estimated value of each incomplete and non-conforming work item. Retainage value will be set at 200 percent estimated value.
        1) Include photograph of each item.
        2) Include back-up financial information for each item.
    d. A short statement of why work is not complete.
    e. Identify subcontract responsibility, as appropriate to each item.
2. Architect's Punch List: A list of incomplete and non-conforming Work prepared by the Architect, which modifies the Contractor's Punch List, following review and acceptance of the Contractor's Punch List.

B. Pre-Closeout requirements: Prior to requesting initial Architect's inspection for Certification of Substantial Completion, submit to the Architect a full and complete list of all non-conforming and incomplete work items (Contractor's Punch List).

C. Punch list procedures at Substantial Completion:
1. Architect will review submitted Contractor's Punch List and determine whether it is suitable to proceed with the Substantial Completion Process.
    a. If the Architect determines that the amount of completed work is insufficient to be considered for Substantial Completion, the Architect will not proceed with the Punch lists process until sufficient completion of the Project is achieved.
    b. The Architect will review the Contractor's Punch List and if the Architect determines that it does not reflect proper identification of the incomplete, and nonconforming work, he/she will request revision and resubmission of the Contractor's Punch List.
    c. If the Architect determines that the amount of work indicated on the Contractor's Punch List is excessive, the Architect will suspend its review until the scope of Work identified in the Contractor's Punch is reduced to a level satisfactory to the Architect.
    d. When the Architect reviews and accepts the Contractor's Punch List as being an accurate reflection of incomplete and incorrect work; the Architect will prepare and issue to the Contractor the "Architect's Punch List".
        1) The Architect's Punch List will be based on the Contractor's Punch List with modifications and additions as may be required.
        2) The Architect's Punch List includes Work which must be completed and corrected prior to Final Completion.
2. Upon receipt of the Architect's Punch List, the Contractor shall immediately distribute the list to all subcontractors.

D. Completion of Punch List Work: Make reasonable efforts to ensure that all "Architect's Punch List" items are completed or corrected within 14 calendar days from the date of the Architect's Punch List" or within the Contract Time, whichever is earlier.

E. Architect's Final Inspection and review of Punch List Work:
1. After Contractor certification that all punch list Work has been properly completed the Architect will then perform the Final Inspection.
    a. Incomplete Items: If the Architect discovers any incomplete or incorrect "Architect's Punch List" items or any other deficiency in the work, the Architect will prepare a "Revised Punch List" which may also include other incomplete Contract requirements

such as record documents, owner's operation and maintenance manuals, warranties, and other Contract requirements. Architect's site reviews of the Work for this "Revised Punch List" and any subsequent revised Punch Lists shall be performed as additional service to Owner, back-charged to the Contractor.
b. The Architect may assign a dollar value for each item of incomplete or incorrect work remaining.

F. Additional Inspections and related additional services fee: The Architect and the Architect's consultants will provide two site inspections, one at Substantial Completion, and one to confirm that the "Architect's Punch List" has been completed.
1. "Revised Punch List: If the Architect prepares and issues a "Revised Punch List: because of the Contractor's failure to complete the Work, then the Owner shall compensate the Architect and the Architect's consultants for their additional services and additional inspections. The payment for additional services and inspections will be backcharged to Contractor. The Owner will deduct the amount of the Architect's additional services fee from final payment to the Contractor by Change Order.

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 comply with Green Seal's 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 designated portion of Project:
a. Clean Project site 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 not planted, mulched, or 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. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    1) Clean HVAC system in compliance with NADCA ACR. Section 230130.52 "Existing HVAC Air-Distribution System Cleaning." Provide written report on completion of cleaning.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Owner and by uploading to web-based project software site. Enable reviewer comments on draft submittals.
2. Submit three paper copies. Architect, will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf 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. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. 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. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. 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.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: 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 Architect.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. 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.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

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. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. 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 has 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.

C. 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.

D. 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.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. 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 warranties and bonds as described below.

C. 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 and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; 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.
    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

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.

E. 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.

F. 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.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. 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.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. 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 maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

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. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product 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 and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.

5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 7839

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

B. Related Requirements:
   1. Section 017700 "Closeout Procedures" for general closeout procedures.
   2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit copies of Record Drawings as follows:
      a. Initial Submittal:
         1) Submit Record Digital Data Files and one set(s) of plots.
         2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal:
         1) Submit Record Digital Data Files and one set(s) of Record Digital Data File plots.
         2) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

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. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
2. Refer instances of uncertainty to Architect for resolution.
3. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

2. Identification: As follows:
    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

1.5 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. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
    5. Note related Change Orders[, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. 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.

C. Format: Submit Record Product Data as annotated PDF electronic file.
    1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 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 PDF electronic file.
    1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 7846

ATTIC STOCK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. Section Includes:

1. Attic Stock
2. Spare Parts

1.3 DEFINITIONS

A. Acceptance: The transfer of goods from an outside entity to the owner that has been documented and acknowledged by both parties in writing.

B. Appropriate Credit: Amount of compensation agreed to by both parties. This value should be the vendor documented purchase price of the material, including tax, shipping, and contractor markup.

C. Attic Stock: Additional material and accessories designated in the design specifications, including but not limited to ceiling tile, fire alarm devices, door hardware, etc.

D. OEM: Original Equipment Manufacturer.

E. OPP: Office of Physical Plant.

F. Perishable Items: Items such as paint, adhesives, and other items with a finite shelf life.

G. PSU: The Pennsylvania State University.

H. Spare Parts: Parts or equipment components that are included in the purchase of the original equipment, and are provided by the OEM for use by the owner.

1.4 ACTION SUBMITTALS

A. Product Data: For each item provided.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare items for storage as follows:

1. Items shall be delivered in undamaged, original packing.
2. Item description and quantity shall be clearly marked on a visible surface of the packaging.
3. Include item technical documentation.

PART 2 - PRODUCTS

2.1 ATTIC STOCK

A. Exterior Cladding Materials

B. Flooring and Base Materials

C. Ceiling Tiles

D. Wall Finishes

E. Window Treatments - 5% shade fabric

2.2 SPARE PARTS

1. The PSU Area Supervisor at University Park or the Maintenance Supervisor at Commonwealth Campus locations is responsible for the acceptance and storage of spare parts. The supervisor has final authority in determining if an item should be accepted.

2. Items included with the purchase of materials or equipment that are considered spare or replacement parts are the property of PSU, and shall be submitted to the area for acceptance and storage.

3. Installation aids, transportation tools and all items that are not deemed as spare parts shall be disposed of per the University waste disposal guideline, or may be retained by the contractor.

PART 3 - EXECUTION

3.1 OWNER DOCUMENTATION REQUIREMENTS

A. Attic Stock additional material requested by the Project Leader shall be coordinated through OPP Stores at University Park or the Maintenance Supervisors at Commonwealth Campus

locations. Items not inventoried in this manner will not be accepted, and an appropriate credit shall be provided to the owner.

1. Specific information required for acceptance of Attic Stock include:
   a. Storeroom location.
   b. Item description.
   c. Item technical information and specification.
   d. Suggested supplier.
   e. Quantity.
   f. Bin location, if known.
   g. Re-order quantity.
      1) At what on-hand quantity should the item be re-ordered?
      2) What is the re-order quantity?
   h. Cost of the item, if known.

B. OPP Stores Information

1. Office
   a. Physical Plant Stores
      Penn State University
      159A Physical Plant Building
      University Park, PA 16802
      Phone: 814-865-1701
      Fax: 814-865-2920
      http://www.opp.psu.edu/about-opp/divisions/afs/mopps
   b. Hours: 7:00 a.m. – 4:30 p.m., Monday –Friday

2. Stockroom
   a. 159A Physical Plant Building
      University Park, PA 16802
      Phone: 814-863-8952
      Fax: 814-865-2930
   b. Hours: 6:00 a.m. – 4:30 p.m., Monday –Friday

3.2 DELIVERY

A. Material shall be delivered directly to an approved, designated storage area, confirmed prior to delivery. Material acceptance must be verified in writing by the requesting party, typically the Area Supervisor.

3.3 STORAGE

A. Mechanical rooms, electrical rooms, telecom, and other service areas are not to be used as storage or staging areas unless prior written approval is obtained from the Area Supervisor and Environmental Health and Safety.

B. Designated storage areas in mechanical spaces must be clearly identified prior to delivery.

END OF SECTION 01 7846

SECTION 01 7900

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:
   a. Name of Project.
   b. Name and address of videographer.
   c. Name of Architect.
   d. Name of Contractor.
   e. Date of video recording.
2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Preconstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.
2. Documentation: Review the following items in detail:
    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.

e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
   1. Submit video recordings on CD-ROM or thumb drive and by uploading to web-based Project software site.
   2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
   3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
   4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
      a. Name of Contractor/Installer.
      b. Business address.
      c. Business phone number.
      d. Point of contact.
      e. Email address.

B. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
   1. Film training session(s) in segments not to exceed 15 minutes.
      a. Produce segments to present a single significant piece of equipment per segment.
      b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
      c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

C. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
   1. Furnish additional portable lighting as required.

D. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

F. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

1.11 SYSTEMS

A. Provide demonstration and training for systems as specified to include but not limited to the following:

1. Electrical switchgear
2. Electrical systems
3. Lighting controls
4. Audio visual
5. Security card access and cameras
6. Generators
7. Exterior lights
8. Fire alarm
9. Fire sprinklers
10. Plumbing
11. Water heaters
12. Air compressors
13. Booster and circulator pumps
14. Refrigeration
15. Boilers
16. Chillers
17. Heating and ventilation
18. Hydronic systems
19. BAS
20. Elevators
21. Fire curtains
22. Roof fall protection
23. Roofing
24.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

SECTION 02 41 10

SITE PREPARATION

PART 1 GENERAL

1.00 RELATED DOCUMENTS

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

1.01 WORK INCLUDED

A. Provide all equipment and do all work necessary to prepare the site, complete, as indicated on the Drawings and as specified.

B. Staging Area: Contractor shall utilize the the area indicated on the Drawings as a staging area unless otherwise directed by the Architect.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 31 25 00, EROSION AND SEDIMENT CONTROL; Erosion control.
2. Section 31 23 00, SITE EXCAVATING, BACKFILLING AND COMPACTING; Excavation and backfill.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American National Standards Institute (ANSI):

Z133.1	Safety Requirements for Pruning, Trimming, Repairing, Maintaining and Removing Trees, and for Cutting Brush
Z133A	Best Management Practices Tree and Shrub Fertilization

2. Commonwealth of Pennsylvania Department of Transportation (PennDOT):

Specifications	Standard Specifications

3. International Society of Arboriculture (ISA):

Guide	Guide for Establishing Values of Trees and Other Plants
Guide	Tree Pruning Guidelines

4. Tree Care Industry Association, 3537 Stratford Rd., Wantagh, NY 11793 (TCIA):

Ref. 1	Pruning Standards for Shade Trees
Ref. 2	Standard for Fertilizing Shade and Ornamental Trees

1.04 SUBMITTALS

A. The following shall be submitted:

1. Certificates of severance of utility services.
2. Permit for transport and legal disposal of debris.
3. Location plan of staging areas and schedule for moving staging equipment into those areas shall be submitted for Architect's approval prior to mobilization and related site preparation operations.

4. A list of all [College] operations and programs to be accommodated during construcrtion period.

B. Submit schedule of existing trees to be pruned and fertilized including extent of pruning and type of fertilizer application.

C. Predemolition photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by site preparation operations. Submit before the Work begins.

1.05 PROTECTION

A. Do not interfere with use of adjacent buildings. Maintain free and safe passage to and from.

B. Cease operations and and notify Architect immediately if safety of adjacent structures appears to be endangered. Take precautions to properly support structures. Do not resume operations until safety is restored.

C. Prevent movement, settlement or collapse of adjacent services, sidewalks, driveways and trees. Assume liability for such movement, settlement, or collapse. Promptly repair damage at no cost to the Owner.

D. Provide, erect, and maintain street boardings, sidewalk shed, barricades, lighting, and guardrails as required to protect general public, workers, and adjoining property.

1.06 EXISTING SERVICES

A. Arrange and pay for disconnecting, removing, capping, and plugging utility services as indicated on the Drawings. Disconnect and stub off. Notify the affected utility company in advance and obtain approval before starting this work.

B. Place markers to indicate location of disconnected services. Identify service lines and capping locations of Project Record Documents.

1.07 MAINTAINING TRAFFIC

A. Do not close or obstruct roadways without permits.

B. Conduct operations with minimum interference to public or private roadways.

PART 2 PRODUCTS

2.01 HERBICIDE

A. Herbicide shall be QuickPro, Roundup Pro or Manage, manufactured by Monsanto Company, 800 North Lindbergh Boulevard, St. Louis, MO – 63167; Tel. (314) 694-1000, or approved equal.

2.02 FERTILIZER

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

PART 3 EXECUTION

3.01 CLEARING AND GRUBBING

A. Trees, shrubs, and other vegetation not indicated on the Drawings or designated in the field by the Architect to remain and required for execution of the Work shall be cleared and grubbed.

1. CLEARING: All objectionable growth shall be stripped. Debris resulting from stripping and clearing operations shall be promptly removed from University property so as to prevent this material from accumulating on the site.

2. GRUBBING: Removal of trees and shrubs shall include the removal of stumps and roots to the extent that no root greater than 3 inches in diameter remains within 5 feet of an underground structure or utility line or under footings or paved areas. Grubbing in open areas shall include removal of stumps and 3 inch roots to 2 feet below finish grade elevations.

B. Stumps shall be removed to their full depth. Roots 3 in. and larger shall be removed to a depth of 2 ft. below finished grade. Stumps shall be legally disposed of off-site.

C. Do not apply herbicide to remaining stumps or plant life to inhibit growth.

D. Limbs 3 in. diameter and larger shall be cut into 4 ft. lengths and delivered and stacked at as directed by the Owner.

3.02 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. Existing structures and utilities shall be suitably protected from damage, including but not limited to existing stone walls, concrete vault, manholes, and utility lines.

3.03 LOAM AND TOPSOIL

A. Loam and topsoil shall be stripped to their full depth from areas to be excavated, filled, regraded, or resurfaced.

B. Loam and topsoil shall be stockpiled on-site and protected. No loam and topsoil shall be removed from the site without the written permission of the Architect.

C. Stockpiled loam and topsoil which conforms to the specifications may be used for fill and finish grading within landscaped areas.

D. Stockpiled loam and topsoil which conforms to Swection 32 92 00, LAWNS AND GRASSES may be used for fill and finish grading within landscaped areas. Material which does not conform, and which is not suitable for use as a granular fill under the work of Section 31 23 00, SITE EXCAVATING, BACKFILLING, AND COMPACTING, shall be deemed unsuitable and shall be removed from the site and legally disposed.

3.04 PAVEMENT AND CURB REMOVAL

A. Where indicated on Drawing, and as directed by the Architect existing asphalt pavement and curb shall be removed and legally disposed of off-site. Where pavement and curb to be removed abuts pavement and curb to remain, a neat, straight saw cut shall be made with a concrete power saw.

3.05 REMODEL EXISTING CATCH BASINS

A. Remodel existing catch basins into manholes as indicated on the Drawings, and in accordance with PennDOT Specifications.

B. Castings shall be carefully removed and stockpiled for reuse on this Project.

C. Materials necessary to make adjustments shall conform to Section 33 40 00, STORM DRAINAGE SYSTEM.

3.06 ADJUST EXISTING MANHOLES AND CATCH BASINS

A. Existing manholes and catch basins shall be adjusted to line and grade as indicated on the Drawings in accordance with PennDOT Specifications.

B. Materials necessary to make adjustments shall conform to Section 33 40 00, STORM DRAINAGE SYSTEM.

3.07 ABANDONMENT OF EXISTING UTILITIES

A. Existing drain inlet indicated on the Drawings shall be abandoned in accordance with PennDOT Specifications.

3.08 REMOVALS

A. Materials indicated on the Drawings or designated by the Architect in the field to be removed shall be dismantled, removed, and legally disposed of off-site or stockpiled as indicated on the Drawings.

B. Areas formerly occupied by structures shall be regraded to conform with surrounding topography following demolition.

3.09 SALVAGEABLE MATERIALS

A. Materials indicated on the Drawings or designated by the Architect in the field to be salvaged shall be carefully removed, protected from damage, and put in temporary storage as follows:

1. Salvaged material shall be stockpiled on-site in an area designated by the Owner.
2. Salvaged material shall be delivered to and stored in an area designated by the Owner.

B. Salvage material shall include but not be limted to the following:
Castings
Gate valves
Granite curbing
Signs and posts
Wheelstops
Catch basin frame and grate
Flagpoles and floodlights
Light poles
Hydrant

3.10 DEMOLITION

A. Existing structures indicated on the Drawings to be removed, shall be completely dismantled and removed from the site.

B. Areas formerly occupied by structures shall be regraded to conform with surrounding topography following demolition.

3.11 TREE PRUNING

A. Tree prunign shall conform to ISA Tree Pruning Guidelines and the following:

1. Pruning of existing trees shall be "Class II Medium Pruning" conforming to TCIA Ref. 1.

3.12 FERTILIZATION

A. Follow guidelines established by ANSI Z133A, Best Management Practices Tree and Shrub Fertilization and the following:

1. Fertilization of existing shade trees shall conform to TCIA Ref. 2.

3.13 DISPOSAL OF MATERIALS

A. Material resulting from the site preparation work and not scheduled to be salvaged and which is unsuitable for reuse on the project, shall become the property of the Contractor and shall be legally disposed of off-site.

B. Debris, rubbish, and other material shall be disposed of promptly and shall not be left until final cleanup of site.

3.16 WASTE MANAGEMENT
A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete Subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Curing compounds.
   6. Floor and slab treatments.
   7. Bonding agents.
   8. Adhesives.
   9. Vapor retarders.
   10. Semirigid joint filler.
   11. Joint-filler strips.
   12. Repair materials.
   13. Waterstops

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: 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.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. 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 average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
   1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301.
   2. ACI 117.

2.2 FORM-FACING MATERIALS

A. 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.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. 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," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view, where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
   2. Fly Ash: ASTM C 618, Class F.
   3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years'

satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Class: Not less than 1S for footings, 2S for interior slabs, 3S for walls and piers, and 4S for exterior pads.
2. Maximum Coarse Aggregate Size: Not larger than one-fifth the narrowest dimensions between the sides of the forms of the member for which the concrete is to be used. In general, the maximum size shall be 1-1/2 inches for foundations, 1 inch for walls and piers, and 3/4 inch for slabs.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
4. Water-reducing and Accelerating Admixture: ASTM C 494, Type E. Product shall have a long history of non-corrosive effect on reinforcing steel.

F. Water: ASTM C 94/C 94M and potable.

2.6 VAPOR RETARDERS

A. Bituminous Vapor Barrier/ Retarder: 110-mil-thick, semiflexible, 7-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release line. Furnish manufacturer’s accessories include bonding asphalt, pointing mastics, and self-adhering joint tape.
1. Acceptable Product: W. R. Meadows, Inc. “Premolded Membrane Vapor Seal with Plasmatic Core.”

B. Plastic Vapor Barrier/ Retarder: Include manufacturer’s recommended adhesive or pressure sensitive tape.
1. Acceptable Products:
   a. W.R. Meadows, Inc.; Perminator 15-Mil.
   b. Fortifiber Corporation; Moistop Ultra 15.
   c. Raven Industries Inc.; Vapor Block 15.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Water-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1; Class A (non-yellowing) for exterior applications that will remain exposed; Class B for all other applications. Acceptable manufacturers:
1. W. R. Meadows

2. L & M Construction Chemicals, Inc.
3. The Euclid Chemical Company
4. Sonneborn, Div. of BASF

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

C. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

E. Waterstops: Flexible PVC Waterstops, CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

F. Waterstops: Self-Expanding Strip Waterstops, manufactured rectangular strip, sodium bentonite or other hydrophilic material for adhesive bonding to concrete.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

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.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Slag Cement: 50 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.
1. Minimum Compressive Strength: As indicated on Drawings.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

B. Piers and Walls: Normal-weight concrete.
1. Minimum Compressive Strength: As indicated on Drawings.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

C. Slabs-on-Grade: Normal-weight concrete.
1. Minimum Compressive Strength: As indicated on Drawings.
2. Maximum W/C Ratio: 044 if non-air–entrained; 0.35 if air-entrained.
3. Slump Limit: 4 inches, 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.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 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 INSTALLATION

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. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that are attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained. In no case, shall the

supporting forms or shoring be removed until the members have acquired sufficient strength to support safely their weight and the load thereon.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Architect.

3.4 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.5 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 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.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate horizontal joints in walls and columns at underside of floors and slabs and at the top of footings or floor slabs.
4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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 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.
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 does 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, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
6. Depositing: Deposit at slumps not greater than those specified, as nearly as practicable in its final position, so as to avoid segregation due to rehandling or flowing. Place concrete

at such a rate that the concrete is at all time plastic and flows readily into the spaces between the bars.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. 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.

3.9 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. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
   1. Apply scratch finish to surfaces to receive concrete floor toppings in resident bathrooms.

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. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. 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; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. 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 platforms, steps, ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:
   1. Coordinate sizes and locations of concrete bases with actual equipment provided.
   2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
   3. Minimum Compressive Strength: 4000 psi at 28 days.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
   6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.11 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 305.1 for hot-weather protection during curing.

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. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. 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 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. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

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.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated 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 the process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least three months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as slabs, to finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured for at least 14 days, correct high areas by grinding.
   3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
   4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
   5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
   7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector, and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Headed bolts and studs.
   4. Verification of use of required design mixture.
   5. Concrete placement, including conveying and depositing.
   6. Curing procedures and maintenance of curing temperature.
   7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
   2. Testing Frequency: Obtain at least one composite sample for each 100-cu. yd. or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
   6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   7. Compression Test Specimens: ASTM C 31/C 31M.
      a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
      a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
      b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
   9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
   10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
   11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
   12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agencies may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
   13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 033000

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Clay face brick.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry-joint reinforcement.
6. Miscellaneous masonry accessories.
7. Mortar and grout mixes.

B. Related Requirements:
1. Section 042000 "Unit Masonry" for clay unit masonry.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. 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 name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.

7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

C. 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 C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. 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 TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, and projections 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.

B. 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.

C. 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.

D. 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 TMS 602/ACI 530.1/ASCE 6.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
   2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
   2. Density Classification: Normal weight.
   3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
   4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Aggregate for Mortar: ASTM C144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. White-Mortar Aggregates: Natural white sand or crushed white stone.

F. Aggregate for Grout: ASTM C404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

H. Water: Potable.

I. Do not use admixtures, including air-entraining agents, accelerators, retarders, or other admixture unless otherwise indicated.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in the 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.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 3/16-inch diameter.
4. Wire Size for Cross Rods: 9-guage diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot dip galvanized to comply with ASTMA 153/A153M.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, 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 felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime 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 weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type S.
   3. For mortar parge coats, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

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

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. 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.

3.3 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.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

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 exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 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. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. 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.

H. Abutting walls shall have alternate courses toothed into adjoining wall.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs 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. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 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.
1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation 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.

E. Cut and bend reinforcing units as directed by the manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.8 REINFORCED UNIT MASONRY

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 TMS 602/ACI 530.1/ASCE 6. Reinforcing shall not be plunged into wet grout.

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 TMS 602/ACI 530.1/ASCE 6 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 60 inches.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner 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 comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
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 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.10 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. 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.

3.11 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.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

END OF SECTION 042200

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Clay face brick.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry-joint reinforcement.
6. Miscellaneous masonry accessories.
7. Mortar and grout mixes.

B. Related Requirements:
1. Section 042000 "Unit Masonry" for clay unit masonry.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. 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 name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.

7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

C. 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 C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. 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 TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, and projections 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.

B. 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.

C. 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.

D. 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 TMS 602/ACI 530.1/ASCE 6.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
   2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
   2. Density Classification: Normal weight.
   3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
   4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Aggregate for Mortar: ASTM C144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. White-Mortar Aggregates: Natural white sand or crushed white stone.

F. Aggregate for Grout: ASTM C404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

H. Water: Potable.

I. Do not use admixtures, including air-entraining agents, accelerators, retarders, or other admixture unless otherwise indicated.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to 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.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 3/16-inch diameter.
4. Wire Size for Cross Rods: 9-guage diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot dip galvanized to comply with ASTMA 153/A153M.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, 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 felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime 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 weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type S.
   3. For mortar parge coats, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

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

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. 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.

3.3 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.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

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 exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 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. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. 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.

H. Abutting walls shall have alternate courses toothed into adjoining wall.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs 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. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 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.
1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation 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.

E. Cut and bend reinforcing units as directed by the manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.8 REINFORCED UNIT MASONRY

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 TMS 602/ACI 530.1/ASCE 6. Reinforcing shall not be plunged into wet grout.

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 TMS 602/ACI 530.1/ASCE 6 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 60 inches.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner 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 comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
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 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.10 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. 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.

3.11 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.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

END OF SECTION 042200

SECTION 04 20 00. C20 BURNISHED (GROUND FACE) CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete Masonry Units
2.Premier Ultra Burnished Loadbearing concrete masonry units
3. Premier Ultra Burnished Non-Loadbearing concrete masonry units

B. Related Sections:

1. 042200 – Concrete Unit Masonry Including masonry mortaring and grouting, masonry anchorage and reinforcement, and masonry accessories.
3. Section 07190 – Water Repellants

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 530 - Building Code Requirements for Masonry Structures.
3. ACI 530.1 - Specification for Masonry Structures.

B. American Society for Testing and Materials (ASTM):

1. ASTM C 270 – Standard Specification for Mortar for Unit Masonry
2. ASTM C 90 - Specification for Load-bearing Concrete Masonry Units 3. ASTM C 140 - Methods of Sampling and Testing Concrete Masonry Units.
4. ASTM E 514 – Standard Test Method for Water Penetration and Leakage Through Masonry

1.3 SUBMITTALS

A. Specified in Section 01330 -Submittal Procedures

B. Color Selection

1. For Initial Selection: Unit masonry sample box-sized samples showing the full range of colors and textures available for each different exposed masonry unit required

1.4 QUALITY ASSURANCE

A. Construction: Construct masonry in accordance with requirements of ACI 530 and 530.1.

B. Special Inspection and Testing: Provide inspection and testing in accordance with the Building Code and as noted on Drawings and will be performed under provisions of Section 01450.

C. Mock-up: Construct a masonry wall mock-up panel to represent the selected exterior masonry wall color, texture characteristics, and bond pattern.

1. Construct wall at least 4 feet long by 4 feet high.
2. Locate where directed by Architect/Owner's Representative.
3. Include bond pattern, joint profile and mortar colors for all face textures and colors.
4. Include reinforcement, flashing and weeps as indicated on drawings.
5. Erect entire mock-up with methods representative of standard, daily construction, and in-progress cleaning practices.
6. Mock-up sample panel must receive acceptance by Architect/Owner's Representative before proceeding with masonry installation.
7. Once accepted, mock-up sample panel will be used as the standard of quality for masonry work on the project
8.Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion

1.5. DELIVERY, STORAGE AND HANDLING

A. Deliver and handle architectural masonry materials to prevent damage.
1. Deliver architectural masonry units wrapped and on wooden pallets
2. Cover stacked masonry units with protective waterproof covering that will allow air circulation between blocks and pallets to prevent excessive moisture accumulation
3. Ground and Polished Face masonry units to be packaged with protective membrane between block layers to minimize chipping.

B. Store architectural masonry units in a location as to minimize handling, exposure to excessive moisture, contaminants, corrosion, and materials that could cause staining.

C. Store mortar materials off the ground with waterproof covering and in a dry location

1.6. PROJECT CONDITIONS

A. Environmental Requirements (Cold Weather): Follow the requirements for Hot and Cold Weather Construction. Include the following construction requirements for cold weather procedures:

1. When ambient air temperatures are above 40 degrees F cover tops of walls and masonry elements with plastic or canvas at end of workday to prevent water from entering masonry.
2. When ambient air temperatures are below 40 degrees F and above 32 degrees F or temperature of masonry units is below 40 degrees F:
    a. Remove visible ice on masonry units before units are placed in the wall.
    b. Do not lay masonry units having a temperature below 20 degrees F.
    c. Heat sand and mix water to produce mortar temperatures between 40 degrees F and 120 degrees F at the time of mixing.
    d. Maintain mortar and grout temperatures above freezing until used in masonry.
    e. Cover tops of walls and masonry elements with weather resistive membrane at end of workday to prevent water from entering masonry.
3. When ambient air temperatures are below 32 degrees F and above 25 degrees F or temperature of masonry units is below 40 degrees F:
    a. Remove visible ice on masonry units before units are placed in the wall.
    b. Do not lay masonry units having a temperature below 20 degrees F.
    c. Heat sand and mix water to produce mortar temperatures between 40 degrees F and 120 degrees F at the time of mixing.
    d. Maintain mortar and grout temperatures above freezing until used in masonry.
    e. Completely cover walls and masonry elements with weather resistive membrane at end of workday and keep covers in place for 24 hours.
4. When ambient air temperature is below 25 degrees F and above 20 degrees F:
    a. Remove visible ice on masonry units before units are placed in the wall.
    b. Do not lay masonry units having a temperature below 20 degrees F.
    c. Heat sand and mix water to produce mortar temperatures between 40 degrees F and 120 degrees F at the time of mixing.
    d. Maintain mortar and grout temperatures above freezing until used in masonry.
    e. Use heat source on both sides of masonry under construction.
    f. Install wind breaks when wind velocity is more than 15 mph.

g. Completely cover walls and masonry elements with insulated blankets or equivalent protection at the end of workday and keep covers in place for 24 hrs.
5. When ambient temperature is below 20 degrees F:
a. Remove visible ice on masonry units before units are placed in the wall.
b. Do not lay masonry units having a temperature below 20 degrees F.
c. Heat sand and mix water to produce mortar temperatures between 40 degrees F and 120 degrees F at the time of mixing.
d. Maintain mortar and grout temperatures above freezing until used in masonry.
e. Provide an enclosure for the masonry under construction.
f. Use heat sources to maintain temperatures above 32 degrees F within the enclosure.
g. Maintain masonry temperature above 32 degrees F for 24 hours after construction by enclosure with supplementary heat, electric heating blankets, infrared heat lamps, or other acceptable methods.

B. Environmental Requirements (Hot Weather): Follow the requirements for Hot and Cold Weather Construction. Include the following construction requirements for hot weather procedures:

1. When ambient temperature is above 115 degrees F or ambient air temperature is above 105 degrees F and wind velocity exceeds 8 mph:
a. Shade materials and mixing equipment from direct sunlight.
b. Maintain sand piles in damp loose condition.
c. Provide necessary conditions and equipment to produce mortar and grout having temperatures below 120 degrees F.
d. Use cool mixing water for mortar and grout.
e. Maintain temperatures of mortar and grout below 120 degrees F.
f. Flush mixer, mortar and grout transport container, and mortarboards with cool water before the encounter mortar or grout.
g. Maintain mortar consistency by re-tempering with cool water.
h. Use mortar within 2 hours of initial mixing.
i. Fog spray all newly constructed masonry until damp, at least three times a day until the masonry is 3-days old.
2. When ambient temperature is above 100 degrees F or ambient air temperature is above 90 degrees F and wind velocity exceeds 8 mph:
a. Maintain sand piles in damp loose condition.
b. Provide the necessary conditions and equipment to produce and maintain mortar and grout having temperatures below 120 degrees F.
c. Maintain mortar and grout temperatures below 120 degrees F.
d. Flush mixer, mortar and grout transport container, and mortarboards with cool water before the encounter mortar or grout.
e. Maintain mortar consistency by re-tempering with cool water.
f. Use mortar within 2 hours of initial mixing.
g. Fog spray all newly constructed masonry until damp, at least three times a day until the masonry is three days old.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Acceptable Manufacturers:

1. County Materials Corporation, 205 North St. P. O. Box 100, Marathon, WI 54448-0100: Tel:715-848-1365: Web: www.countymaterials.com.
Westbrook Concrete Block, 439 Spencer Plains Road. P.O.Box 700 Westbrook CT 06498. Tel: 860-399-6201. https://www.westbrookblock.com.

York Building Products 950 Smile way, York, PA 17404. https://www.yorkbuilding.com

2. Substitutions: FOLLOW PSU Front End instructions.

2.2 Concrete Masonry Units

A. Concrete Masonry Units – General:

1. Provide concrete masonry standard units as indicated and scheduled with face dimensions of 16 inches long by 8 inches high, nominal; 15-5/8 inches long by 7-5/8 inches high, actual, by thicknesses indicated on drawings
2. Provide special masonry units for bond beams, control and expansion joints, and lintels.
3. Hollow and solid load-bearing block: ASTM C-90, normal weight, 125 pounds per cubic foot dry weight minimum.

B. Premier Ultra Burnished Masonry Units: County Materials Corporation: all units produced with integral water repellant admixture.

1. Premier Ultra Burnished; Manufactured by County Materials Corporation.
   a. Description: Normal weight, integrally pigmented load bearing unit
   b. Compliance: ASTM C90
   c. Coloring: Integral, Through-body coloring
   d. Water Repellent: Integral Water Repellent
   e. Color: Selected from manufacturer's standard range.
   f. Color: To be selected from manufacturers Full Range
   g. Finish: Ground Face

2.3 ANCHORAGE AND REINFORCING

A. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast-stone material.

Epoxy Coating: ASTM A 775/A 775M.

Galvanized Coating: ASTM A 767/A 767M

Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304

2.4 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666

B. Dowels: 1/2-inch- diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to the start of masonry construction, the Contractor shall verify:

1. Foundations are constructed with tolerances conforming to ACI 117.
2. Reinforcing dowels are positioned in accordance with Project Drawings.
3. Verify items provided by other Sections of the Work are properly sized and located.

B. If conditions are not met notify the Architect/Owners Representative.

3.2 PREPARATION

A. Establish Lines, Levels, and Coursing:

1. Protect lines from disturbance.
2. Use non-corrosive materials in contact with masonry.

B. Surface Preparation: Prior to placing masonry units remove, loose aggregate or any other materials that would prevent mortar from bonding to the foundation.

3.3. COURSING AND BONDING

A. Placement: Place masonry units to lines and levels indicated on plans.
B. Uniformity: Maintain masonry coursing and horizontal joints of uniform width and thickness.
C. Bond Patterns: Place masonry units in running bond pattern unless otherwise noted on plans.
D. Course Height: Course one masonry unit and one mortar joint to equal 8 inches (4 inches for ½ high units)

3.4 PLACING

A. Bed and Head Joints:
1. Joint Thickness:
a. Construct 3/8-inch bed and head joints unless otherwise indicated.
b. Construct bed joint at starting course on foundation not less than ¼ inch and not more than ¾ inch.
2. Fill holes not specified in exposed and below grade masonry with mortar.
3. Tool head and bed joints concave unless below grade or above ceiling height and to be concealed.
a. Use tool with large enough radius that joint is not raked free of mortar.
4. Remove masonry protrusions extending ½ inch or more into cells or cavities to be grouted.

B. Unit Placement:
1. Lay masonry units with bed and head joints filled from the faces of the units to a distance in not less than the thickness of the face shell.
a. Vertical cells to be grouted are aligned and unobstructed openings for grout must be provided in accordance with drawings.
2. Keep cavity airspace and weep holes clean of mortar, clean out promptly if mortar falls into cavity airspace or plugs weep holes.
3. Remove excess mortar
a. Protect wall from mud splatter and mortar droppings.
b. Place masonry units such that mortar does not run down the face of the wall or smear the masonry face.
4. Adjustments:
a. Do not shift or tap masonry units after mortar has taken initial set.
b. Where adjustments must be made, remove mortar and replace.
5. Protection: Protect wall cavities during construction to prevent rainwater saturation and excessive moisture accumulation.

3.5 TOLERANCES: Erect masonry within the following tolerances from specified dimensions:

A. Dimension of Elements:
1. In cross-section or elevation: minus ¼ inch, plus ½ inch 2. Mortar joint thickness:
a. Bed joints: plus, or minus 1/8 inch
b. Head joints: plus 3/8 inch to minus ¼ inch
c. Collar joints: plus 3/8 inch to minus ¼ inch

B. Elements
1. Variation from level:

a. Bed joints: plus, or minus1/4 inch in 10 feet; plus or minus 1/2 inch maximum.
b. Top surface of bearing walls: plus or minus1/4 inch in 10 feet; plus or minus ½ inch maximum.

2. Variation from plumb: plus or minus 1/4 inch in 10 feet; plus or minus 3/8 inch in 20 feet; plus or minus 1/2 inch max.
3. True to line: plus or minus 1/4 inch in 10 feet; plus or minus 3/8 inch in 20 feet; plus or minus 1/2 inch maximum.
4. Alignment of columns and walls (bottom versus top):
a. Bearing: plus or minus 1/2 inch.
b. Non-bearing: plus or minus 3/4 inch

C. Location of elements:
1. Indicated in plan: plus or minus ½ inch in 20 feet; plus or minus ¾ inch maximum
2. Indicated in elevation: plus or minus ¼ inch in story height; plus or minus ¾ inch max.

C. Notification: If the above conditions cannot be met, notify Architect/Owner's Representative.

3.8 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses within seven days by dry brushing to remove excess mortar and smears before tooling joints, as described in section 3.04.B.3.

B. Final Cleaning: Clean exposed masonry as follows:
1. Clean masonry before installing windows, door, finished flooring, metal fixtures, hardware, light fixtures, roofing materials and other non-masonry items.
2. If already installed, protect from cleaning solution with polyethylene film or waterproof masking tape.
3. Remove large mortar particles by hand with wooden paddles and non-metallic tools
4. Always test cleaner on sample panel or small area to demonstrate products, procedures and stain suitability of each type of stain
5. Materials: Clean masonry units with the following masonry cleaners:
a. For Burnished Face use:
i. Sure Klean Burnished Custom Masonry Cleaner, by Prosoco as per manufacturer’s instructions and cleaning procedures.
ii. MND80 New Masonry Detergent, By EaCo Chem as per manufacturer’s instructions and cleaning procedures

C. Sealer:
A field coat application of concrete sealer including but not limited to matte finishes, high gloss, graffiti control, salt protection or densifiers.
Sealing agent manufacturers recommended with Premier Ultra Burnished Masonry Units are TK Products Construction Coatings, and PROSOCO.

END OF SECTION

SECTION 04 26 13 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Mortar materials.
3. Ties and anchors.
4. Embedded flashing.
5. Accessories.
6. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in masonry veneer.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing.
2. Fabricated Flashing: Detail corner units and other special applications.

C. Samples for Initial Selection:

1. Clay face brick, in the form of straps of five or more bricks.
2. Weep/cavity vents.

D. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep/cavity vents.
4. Cavity drainage material.
5. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For testing agency.

B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

C. 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. Qualifications:

1. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

1.6 MOCKUPS

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 40 00 "Quality Requirements" for mockups.

1. Build sample panels for exposed unit masonry construction 48 inches48 inches high by full thickness.
2. Build sample panels facing south.
3. Clean one-half of exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities.
    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer 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 face of veneer and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with 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.

C. 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 TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. For exposed masonry units, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work.

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBS.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
   a. https://www.glengery.com/
   b. Belden Brick Company (The).
   c. Triangle Brick Company. https://www.trianglebrick.com/
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
4. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
5. Application: Use where brick is exposed unless otherwise indicated.
6. Color and Texture: TBD.

2.4 MORTAR MATERIALS

A. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.

B. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. 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 A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.

C. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.

2. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Hohmann & Barnard, Inc.
2)Model: HB-213-2X

2.6 EMBEDDED FLASHING

A. Flexible Flashing: Use the following:

1. Copper Fabric Flashing: 5 oz./sq. ft. self-adhesive copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Hohmann & Barnard, Inc.
2)Type: Copper SA

B. Termination Bars for Flexible Flashing: Use the following:

1. Type 304 stainless steel, 26-gauge steel bar with 3/8-inch flange at top for caulking.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Hohmann & Barnard, Inc.
2)Type: T2.
3)Option: T2-FTS (Foam-Tite Seal).

2.7 ACCESSORIES

A. Weep/Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Hohmann & Barnard, Inc.
2)Model: QV – Quadro-Vent.

B. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Mortar Deflector: Strips, full depth of cavity and high, with dovetail-shaped notches that prevent clogging with mortar droppings.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Hohmann & Barnard, Inc.
2)Model: Mortar Trap.

C. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.

2.8 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use Portland cement-lime mortar.
3. For exterior masonry, use Portland cement-lime mortar.
4. 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. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

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. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 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 ft., 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

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 exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.4 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. Bond Pattern for Exposed Masonry: Lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

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.

3.5 MORTAR BEDDING AND JOINTING

A. Lay 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.

B. Lay hollow brick with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

C. Set cast-stone trim units in full bed of mortar with full vertical joints.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.
   4. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed tie sections in masonry joints.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of sheathing.
   1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:
   1. Form open joint full depth of brick wythe and of width of masonry joint for installation of sealant and backer rod.

3.8 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under weather-resistive barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar. Seal top of termination bar with silicone caulking.
   2. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Space weep holes 24 inches o.c.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

E. Install vents in head joints in exterior wythes at 24 inches o.c. Use specified weep/cavity vent products to form vents.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections. Allow inspectors access to work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

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 non masonry 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.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.11 MASONRY WASTE DISPOSAL

A. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 04 26 13

SECTION 04 72 00-ARCHITECTURAL CAST STONE

PART 1 GENERAL

1.1 SECTION INCLUDES

Architectural Cast Stone.

1.2 RELATED SECTIONS

A. Section 04 05 13.23 - Surface Bonding Masonry Mortaring.
B. Section 04 05 16.26 - Engineered Masonry Grouting- Masonry Grouting.
C. Section 04 05 19.29 - Stone Anchors.
D. Section 04 20 00 - Unit Masonry.
E. Section 07 60 00 - Flashing and Sheet Metal
F. Section 07 90 00 - Joint Protection

1.3 REFERENCES

A. ACI 318 - Building Code Requirements for Reinforced Concrete.
B. ASTM A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
C. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Reinforced Concrete.
D. ASTM C 33 - Standard Specification for Concrete Aggregates.
E. ASTM C 150 - Standard Specification for Portland Cement.
F. ASTM C 595 - Blended Cement
G. ASTM C 1157 - Hydraulic Cement
H. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volume Method.
I. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
J. ASTM C 260 - Standard Specification for Air-Entrained Admixtures for Concrete.
K. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.
L. ASTM C 426 - Standard Test Method for Linear Shrinkage of Concrete Masonry Units.
M. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete.
N. ASTM C 618 - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
O. ASTM C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
P. ASTM C 979 - Standard Specification for Coloring Pigments for Integrally Pigmented Concrete.
Q. ASTM C 989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete.
R. ASTM C 1116 - Standard Specification for Fiber Reinforced Concrete and Shotcrete.
S. ASTM C 1194 - Standard Test Method for Compressive Strength of Architectural Cast Stone.
T. ASTM C 1195 - Standard Test Method for Absorption of Architectural Cast Stone.
U. ASTM C 1364 - Standard Specification for Architectural Cast Stone.
V. ASTM D 2244 - Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

1.4 DEFINITIONS

A. Cast Stone: Refined architectural concrete building unit manufactured to simulate natural cut stone, used in Division 4 masonry applications.

B. Dry Cast: Manufactured from zero slump concrete.

C. Vibrant Dry Tamp (VDT) Casting Method: Vibratory ramming of earth moist, zero-slump concrete against a rigid mold until it is densely compacted.

D. Machine casting method: Manufactured from earth moist, zero-slump concrete compacted by machinery using vibration and pressure against a mold until it is densely consolidated.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
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 instructions.
4.Cast Stone Institute Plant Certification.
C. Shop Drawings: Include profiles, cross-sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, annotation of stone types and their location.
D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and textures selected.
F. Test Results: Submit manufacturer's representative test results of Cast Stone made by the manufacturer. Certify products provided meet or exceed specified requirements.
G. Closeout Submittals:
1.Provide Cast Stone Institute Member Limited Warranty
2.Provide manufacturer's maintenance instructions that include recommendations for cleaning and maintenance.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1.Member of the Cast Stone Institute with a minimum of 10 years documented experience with projects of similar size and scope.
2.Submit a written list of similar projects at least 3 years of age, with owner, architect and contractor references for each.
3.Cast Stone produced in a plant certified by the Cast Stone Institute.
4.Sufficient plant facilities to produce the shapes, quantities and size of Cast Stone required in accordance with the project schedule.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone units secured to shipping pallets and protected from damage and discoloration.
B. Store products off the ground and under cover in manufacturer's unopened packaging until ready for installation.
C. Mark production units with the identification marks as shown on the shop drawings.

D. Protect units from staining or damage during shipping and storage.
E. Provide an itemized list of product to support the bill of lading.
F. Protect cast stone units, including corners and edges, during storage, handling, and installation to prevent chipping, cracking, staining, or other damage.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

A. Provide a 10 year Limited Product Warranty for the Cast Stone supplied.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Midwest Cast Stone , which is located at: 1610 State Ave.; Kansas City, KS 66102 ; Tel: 913-371-3300 ; Fax: 888-830-1954; Email: request info (david@midwestcaststone.com); Web: www.midwestcaststone.com
B. Sun Precast Company. Or equal

2.2 ARCHITECTURAL CAST STONE

A. Unit Sizes and Shapes: Provide Architectural Cast Stone in the sizes and shapes indicated on the Drawing. Architectural cast stone shall comply with the requirements of ASTM C 1364 and be provided with the following physical properties:
1.Compressive Strength ASTM C 1194: 6,500 psi minimum at 28 days.
2.Absorption ASTM C 1195: 6 percent maximum by the cold water method, or 10 percent maximum by the boiling method at 28 days.
3.Air Content ASTM C 173 or C 231: For wet cast product 4 to 8 percent for units exposed to freeze-thaw environments. Air entrainment is not required for VDT products.
4.Freeze-thaw ASTM C 1364: CPWL shall be less than 5 percent after 300 freeze/ thaw cycles.
5.Linear Shrinkage ASTM C 426: Not exceed 0.065 percent.

B. Cast Stone Materials: Materials shall match those required to product results matching the physical properties specified, the colors and finishes of the Architects file sample and the following:
1.Portland cement: Type I or Type III, white and/or grey, ASTM C 150.
2.Coarse aggregates: Granite, quartz or limestone, ASTM C 33, except for gradation.
3.Fine aggregates: Manufactured or natural sands, ASTM C 33, except for gradation.
4.Colors: Inorganic iron oxide pigments, ASTM C 979 except that carbon black pigments shall not be used.
5.Admixtures: Comply with the following:
a.ASTM C 260 for air-entraining admixtures.
b.ASTM C 494/C 495M Types A - G for water reducing, retarding, accelerating and high range admixtures.
c. Other admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.

d. ASTM C 618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
e. ASTM C 989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features

6.Water: Potable.
7.Reinforcing Bars: ASTM A 615/A 615M: Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 inches.
8.Welded Wire Fabric: ASTM A 185 where applicable for wet cast units.
9.Fiber reinforcement (optional): ASTM C 1116
10.Anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304

C. Related Products:

Use Type 304 stainless steel anchors for highly corrosive environments, such as coastal areas, and for 100-year type construction. Shelf angles and other similar structural items should be galvanized. Midwest Cast Stone does not supply anchoring hardware, but will assist in specifying anchors for a specific applications.

1.Anchors: As scheduled or indicated on Drawings.
2.Anchors: Brass, non-corrosive, sized for conditions.
3.Anchors: Hot-dip galvanized steel, sized for conditions.
4.Anchors: Type 304 stainless steel, sized for conditions.
5.Cleaners: Prosoco Enviro Klean Safety Klean.
6.Cleaners: Prosoco Sure Klean 600 Detergent.
7.Mortar: Type N, ASTM C 270 as specified in Section 04 05 13.23 - Surface Bonding Masonry Mortaring Masonry Mortar.
8.Joint Sealant: As specified in Section 07 91 26 - Joint Fillers.
9.Water Repellant: Prosoco Sure Klean Weather Seal Siloxane WB.
10.Water Repellant: Prosoco Sure Klean Weather Seal Siloxane PD

2.3 FABRICATION

A.Cast Stone Shapes: Unless otherwise indicated on Drawings, provide:
1.Suitable wash on exterior sills, copings, projecting courses, and units with exposed top surfaces.
2.Drips on projecting units, wherever possible.

B.Color and Finish:
1.Match sample(s) on file at the Architect's location.
2.Surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 inch and the density of such voids shall be less than 3 occurrences per any 1 square inch area and not obvious under direct daylight illumination at a 5 foot distance.
3.Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 foot distance.
4. ASTM D 2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
a.Total color difference - not greater than 6 units.
b.Total hue difference - not greater than 2 units.

5.Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 20-ft distance.
6.The occurrence of crazing or efflorescence shall not constitute a cause for rejection.
7.Remove cement film, if required, from exposed surfaces prior to packaging for shipment

C.Reinforcing:

1.Reinforce the units as required by the Drawings and as recommended by the manufacturer for safe handling and structural stress.
2.Minimum reinforcing shall be 0.25 percent of the cross section area.
3.Reinforcement shall be noncorrosive where faces exposed to weather are covered with less than 1.5 inches of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.
4.Panels, soffits and similar stones greater than 24 inches (600 mm) in one direction shall be reinforced in that direction. Units less than 24 inches (600 mm) in both their length and width dimension shall be non-reinforced unless otherwise specified.
5.Welded wire fabric reinforcing shall not be used in dry cast products.

D.Curing:

1.Cure in a warm curing chamber approximately 100 degrees F (37.8 degrees C) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 70 degrees

F (21.1 degrees C) for 16 hours after casting.

2.Additional yard curing at 95 percent relative humidity shall be 350 degree days (i.e. 7 days @ 50 degrees F (10 degrees C) or 5 days @ 70 degrees F (21 degrees C)) prior to shipping.
3.Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

E.Production Tolerances:

1.Cross section dimensions shall not deviate by more than +/- 1/8 inch from approved dimensions.
2.Length of units shall not deviate by more than length/ 360 or +/- 1/8 inch, whichever is greater, not to exceed +/- 1/8 inch.
3.Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the Architect.
4.Warp, bow or twist of units shall not exceed length / 360 or +/- 1/8 inch, whichever is greater.
5.Location of dowel holes, anchor slots, flashing grooves, false joints and similar features; on formed sides of unit, 1/8 inch, on unformed sides of unit, 3/8 inch maximum deviation.

2.4 SOURCE QUALITY CONTROL

A. Test compressive strength and absorption from specimens taken from every 500 cubic feet of product produced.
B. Perform tests in accordance ASTM C 1194 and C 1195.
C. Have tests performed by an independent testing laboratory every six months.
D. New and existing mix designs shall be tested for strength and absorption compliance prior to producing units.
E. Retain copies of all test reports for a minimum of two years.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate 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 in accordance with manufacturer's instructions, ACI 530.1 and approved submittals.
1. Check Cast Stone materials for fit and finish prior to installation. Unacceptable units shall not be set.
2. Set units in full bed of mortar, unless otherwise indicated on the Drawings. It is not necessary to rake joints for later tuckpointing; standard full mortar application with tooling.
3. Vertical Joints: Fill vertical joints with mortar.
4. Head Joints: Leave head joints in copings and similar components open for sealant.
5. Joints:
    a. Width: 3/8 inch wide; unless otherwise indicated on the Drawings or elsewhere in the specifications.
    b. Mortar joints should have a slight concave profile; unless otherwise indicated on the Drawings or elsewhere in the specifications.
6. Remove excess mortar immediately; remove mortar fins and smears before tooling joints.
7. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
8. Cover wainscot for protection and bond separation with plastic, felt paper or other approved products.
9. Cover freshly installed masonry products as required to assist with the curing process.

B. Control Joints: Provide as indicated on the Drawings and In accordance with the following:
1. NCMA TEK Bulletin 5-2A: Clay and Concrete Masonry Banding Details.
2. NCMA TEK Bulletin 10-1A: Design of Concrete Masonry for Crack Control.
3. NCMA TEK Bulletin 10-2C: Control Joints for Concrete Masonry Walls - Empirical Method.

C. Inspection:

1. Inspect finished installation according to Cast Stone Institute Technical Bulletin #36.
2. Do not field apply sealer water repellent until repair, cleaning, inspection is completed.

D. Sealant Joints:
1. As specified in Section 07 91 26 - Joint Fillers.
2. Prime ends of units, insert properly sized backing rod, and install sealant.
3. Provide sealant joints at following locations:
    a. Copings and cast stone units with exposed tops.
    b. Joints at relieving angles.
    c. Control and expansion joints.
    d. As indicated on the drawings.

3.4 TOLERANCES

A. Comply with Cast Stone Institute Technical Manual and the following.

1.Variation from Plumb: Do not exceed 1/8 inch in 5 feet or 1/4 inch in 20 feet or more.
2.Variation from Level: Do not exceed 1/8 inch in 5 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
3.Variation in Joint Width: Do not vary joint thickness more than 1/8 inch or 1/4 of nominal joint width, whichever is greater.
4.Variation in Plane Between Adjacent Surfaces: Do not exceed 1/8 inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.5 REPAIR AND CLEANING

A. Repair chips with touchup materials furnished by manufacturer.
B. Clean exposed units after mortar is thoroughly set and cured.
C. Areas with heavy soiling use a wood block or non-metallic scraper.
D. Apply approved cleaner to units in accordance with manufacturer's instructions.

3.6 WATER REPELLENT

A. Apply water repellant for weatherproofing in accordance with water repellant manufacturer's instructions, after installation, cleaning, repair, inspection, and acceptance of units are completed

3.7 PROTECTION

A . Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL FRAMING

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. Structural steel.
2. Grout.

B. Related Requirements:
1. Section 05 5000 "Metal Fabrications" for miscellaneous steel fabrications, and other steel items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

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

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

C. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 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 schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50 as indicated.

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Weight Class: Standard, unless noted otherwise.
2. Finish: Black except where indicated to be galvanized].

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain typically. Mechanically deposited zinc coating at galvanized members.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain typically. Hot-dip zinc coating, ASTM A 153/A 153M, Class C at galvanized members

E. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened, or ASTM A 36/A 36M carbon steel.
3. Finish: Plain typically. Hot-dip zinc coating, ASTM A 153/A 153M, Class C at galvanized members.

2.4 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.5 GROUT

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

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning", SSPC-SP 2, "Hand Tool Cleaning", or SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 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: Snug tightened.

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. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 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. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

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."
2. SSPC-SP 3, "Power 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.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option, unless noted otherwise:

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 are not accepted.
3. Ultrasonic Inspection: ASTM E 164. Inspect 10 percent of complete penetration groove welds.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates and Leveling 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. Snug-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.
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 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. 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 is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 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: Snug tightened.

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.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option, unless noted otherwise:

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 are not accepted.
c. Ultrasonic Inspection: ASTM E 164. Inspect 10 percent of complete penetration groove welds.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 1200

SECTION 061000 - ROUGH CARPENTRY

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. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Rooftop equipment bases and support curbs.
4. Wood blocking, cants, and nailers.
5. Wood furring and grounds.
6. Wood sleepers.
7. Plywood backing panels.

B. Related Requirements:
1. Section 061063 "Exterior Rough Carpentry."
2. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated wood.
   2. Fire-retardant-treated wood.
   3. Engineered wood products.
   4. Power-driven fasteners.
   5. Post-installed anchors.
   6. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
   1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
1. Application: Interior partitions not indicated as load bearing.
2. Species:
a. Southern pine or mixed southern pine; SPIB.
b. Hem-fir; WCLIB, or WWPA.
c. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
d. Eastern softwoods; NeLMA.
e. Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions:
1. Application: Exterior walls and interior load-bearing partitions.
2. Species: As indicated on the Drawings.

C. Ceiling Joists: Construction or No. 2 grade.
1. Species:
a. Douglas fir-larch; WCLIB or WWPA.
b. Southern pine or mixed southern pine; SPIB.
c. Hem-fir; WCLIB or WWPA.
d. Douglas fir-south; WWPA.
e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
f. Eastern softwoods; NeLMA.
g. Western woods; WCLIB or WWPA.

D. Joists, Rafters, and Other Framing Not Listed Above:
1. Species: As indicted on the Drawings.

2.4 TIMBER FRAMING

A. Comply with the following requirements, according to grading rules of grading agency indicated:
1. Species and Grade: Douglas fir-larch, or Douglas fir-south; No. 1 grade; WCLIB, or WWPA.
2. Species and Grade: Hem-fir or hem-fir (north); [Select Structural] [No. 1] grade; NLGA, WCLIB, or WWPA.
3. Species and Grade: Southern pine; No. 1 grade; SPIB.

4. Maximum Moisture Content: 20 percent.
5. Additional Restriction: Free of heart centers.

2.5 ENGINEERED WOOD PRODUCTS

A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
1. Basis of Design:LVL by Boise Cascade.
2. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal- depth members.
3. Modulus of Elasticity, Edgewise: 1,900,000 psi.

C. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
1. Basis of Design: Boise Cascade.
2. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 12-inch nominal- depth members.
3. Modulus of Elasticity, Edgewise: 2,000,000 psi.

D. Wood I-Joists (TJI): Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D5055.
1. Basis of Design: Boise Cascade.
2. Web Material: Either OSB or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1.
3. Structural Properties: Depths and design values not less than those indicated.
4. Comply with APA PRI-400. Factory mark I-joists with APA-EWS trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA-EWS standard.

E. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research or evaluation report for I-joists.
1. Manufacturer: Provide products by same manufacturer as I-joists.
2. Material: All-veneer product, glued-laminated wood or product made from any combination solid lumber, wood strands, and veneers.
3. Thickness: 1-1/4 inches.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any of the following species:

1. Mixed southern pine or southern pine; SPIB.
2. Hem-fir; WCLIB or WWPA.
3. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
4. Western woods; WCLIB or WWPA.
5. Eastern softwoods; NeLMA.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.
1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.9 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
   1. Use for wood-preservative-treated lumber and where indicated.

D. Joist Hangers: U-shaped joist hangers with 2-inch- long seat and 1-1/4-inch- wide nailing flanges at least 85 percent of joist depth.
   1. Thickness: 0.062 inch, minimum.

E. I-Joist Hangers: U-shaped joist hangers with 2-inch- long seat and 1-1/4-inch- wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
   1. Thickness: 0.062 inch, minimum.

F. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch- minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.

G. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.

H. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

I. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36 inches long.

J. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.

J. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

L. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
   2. ICC-ES evaluation report for fastener.

M. Use steel common nails unless otherwise indicated. Use hot-dipped galvanized or stainless steel fasteners in exterior conditions. Select fasteners of size that will not fully 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. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction unless otherwise indicated.
   1. For exterior walls, provide 2-by-6-inch nominal size wood studs spaced 16 inches o.c. unless otherwise indicated.
   2. For interior partitions and walls, provide 2-by-4-inch nominal size wood studs spaced 16 inches o.c. unless otherwise indicated.
   3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
   4. At multiply member bearing, provide built-ups studs with the number or stud plies matching the number of member plies, unless noted otherwise.

B. Construct corners and intersections with three or more studs.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
   1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
   2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings, unless noted otherwise. Provide headers of depth indicated.

3.5 FLOOR JOIST FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
   1. Where supported on wood members, by toe nailing or by using metal framing anchors.

2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches and do not embed more than 4 inches.

C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.

D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches from top or bottom.

E. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.

F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.

G. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c., extending over and fastening to three joists. Embed anchors at least 4 inches into grouted masonry with ends bent at right angles and extending 4 inches beyond bend.

H. Provide solid blocking between joists under jamb studs for openings.

I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

J. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.
1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal- size lumber, double-crossed and nailed at both ends to joists.
2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.6 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- size or 2-by-4-inch nominal- size stringers spaced 48 inches o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.

2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.7 TIMBER FRAMING INSTALLATION

A. Install timber beams with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.

B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch airspace at sides and ends of wood members.

C. Install wood posts using metal anchors indicated.

D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

3.8 STAIR FRAMING INSTALLATION

A. Provide stair framing members of size, space, and configuration indicated or, if not indicated, to comply with the following requirements:
1. Size: 2-by-12-inch nominal size, minimum.
2. Material: Laminated-veneer lumber, parallel-strand lumber or solid lumber.
3. Notching: Notch rough carriages to receive treads, risers, and supports; leave at least 3-1/2 inches of effective depth.
4. Spacing: At least three framing members for each 36-inch clear width of stair.

B. Provide stair framing with no more than 3/16-inch variation between adjacent treads and risers and no more than 3/8-inch variation between largest and smallest treads and risers within each flight.

3.9 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wood blocking, cants, and nailers.
2. Plywood backing panels.

B. Related Requirements:

1. Section 06 16 00 "Sheathing."

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NHLA: National Hardwood Lumber Association.
2. SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece and omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to

accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

E. Application: Treat the following:

1. Concealed blocking.
2. Wood nailers and blocking.
3. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine; SPIB.
3. Spruce-pine-fir; NLGA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, fire-retardant treated not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 061600 - SHEATHING

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. Wall sheathing.
   2. Roof sheathing.
   3. Subflooring.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for plywood backing panels.
   2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   3. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated plywood.

B. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 WALL SHEATHING

A. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing.
   1. Span Rating: Not less than 24/0.
   2. Nominal Thickness: Not less than 5/8 inch (16 mm).

B. Composite Insulating Wall Sheathing: Oriented-strand-board Exposure 1 sheathing 7/16 inch thick, with factory-laminated water-resistive barrier exterior facer, and with rigid foam plastic insulating board laminated to interior face.

   1. Basis-of-Design Product: Huber Engineered Woods LLC; ZIP System R Sheathing.
   2. Span Rating and Performance Category of Sheathing Layer: Not less than 24/16; 7/16 Performance Category.
   3. Thickness: 2 inch.
   4. Thermal Resistivity (R Value): 6.6 deg F x h x sq. ft./Btu x in. at 75 deg F
   5. Edge Profile: Square edge.
   6. Exterior Facer: Medium-density, phenolic-impregnated polymer-modified sheet material meeting requirements for ASTM D779 Grade D weather-resistive barrier in accordance with ICC AC38 and AC310.

2.4 ROOF SHEATHING

A. Plywood Sheathing: DOC PS 1 Exterior, Structural I sheathing.
   1. Span Rating: Not less than 32/16.
   2. Nominal Thickness: Not less than 5/8 inch (16 mm).

2.5 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: DOC PS 1 Exposure 1, Structural I single-floor panels or sheathing.
   1. Span Rating: Not less than 48/24.
   2. Nominal Thickness: Not less than 23/32 inch

B. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch over smooth subfloors and not less than 3/8 inch over board or uneven subfloors.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

B. Seam Tape and Sealant: Pressure-sensitive, self-adhering, cold-applied, seam tape consisting of polyolefin film with acrylic adhesive, meeting ICC AC148, as recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:
   1. Subflooring:
      a. Glue and nail to wood framing.
      b. Space panels 1/8 inch apart at edges and ends.
   2. Wall and Roof Sheathing:
      a. Nail to wood framing.
      b. Space panels 1/8 inch apart at edges and ends.
   3. Underlayment:
      a. Nail to subflooring.
      b. Space panels 1/32 inch apart at edges and ends.
      c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

C. Joint Treatment - Walls: Install sealant between panel joints and apply joint tape in accordance with manufacturer’s directions.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Prepare test and inspection reports.

END OF SECTION 061600

SECTION 07 16 00 – UNDERSLAB VAPOR RETARDER

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Application of an under slab vapor retarder.

1.02 RELATED SECTIONS

A. Section 03300 - Concrete.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)
1. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil Or Granular Fill Under Concrete Slabs.
2. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
3. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
4. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
5. ASTM F1249-01 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

B. American Concrete Institute (ACI)
1. ACI 302.1R-96 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick.

1.04 SUBMITTALS

A. Comply with Section 01330 - Submittal Procedures.

B. Submit manufacturer's product data and application instructions.

DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean dry area in accordance with manufacturer's instructions.

C. Stack membrane on smooth ground or wood platform to eliminate warping.

D. Protect materials during handling and application to prevent damage or contamination.

E. Ensure membrane is stamped with manufacturer’s name, product name and membrane thickness at intervals of no more than 85” (220 cm).

1.06 ENVIRONMENTAL REQUIREMENTS

A. Product not intended for uses subject to abuse or permanent exposure to the elements.

B. Do not apply on frozen ground

PART 2 PRODUCTS

2.01 MANUFACTURER

A. W.R. Meadows, Inc., PO Box 338, Hampshire, Illinois 60140-0338. (800) 342-5976. (847) 683-4500. Fax (847) 683-4544. Web Site www.wrmeadows.com.
1. Acceptable Products:
a. W.R. Meadows, Inc.; Perminator 10-Mil.
b. Fortifiber Corporation; Moistop Ultra 10.
c. Raven Industries Inc.; Vapor Block 10

2.02 MATERIALS

A. Plastic Vapor Retarder
1. Performance Based Specification: Vapor Retarder membrane must meet or exceed all requirements of ASTM E1745 Classes A, B, & C.
a. Maximum Permeance ASTM E96: 0.024 Perms
b. Water Vapor Transmission Rate ASTM F1249 calibrated to ASTM E96 (water method): 0.012 grains/ft^2/hr
c. Resistance to Organisms and Substrates in Contact with Soil ASTM E154, Section 13: 0.051 Perms
d. Tensile Strength ASTM E154, Section 9: 52 LBS. Force/Inch
e. Puncture Resistance ASTM D1709, Method B: 3,770 Grams
f. Water Vapor Retarder ASTM E1745: Meets or exceeds Class A, B & C
g. Thickness of Retarder (plastic) ACI 302.1R-96: Not less than 10 mils

B. ACCESSORIES

1. Seam Tape
High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4 inches.
2 Pipe Boots
Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.02 SURFACE PREPARATION

A. Prepare surfaces in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643–98.

B. Unroll vapor barrier with the longest dimension parallel with the direction of the pour.

C. Lap vapor barrier over footings and seal to foundation walls.

D. Overlap joints 6 inches and seal with manufacturer's tape.

E. Seal all penetrations (including pipes) with manufacturer's pipe boot.

F. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.

G. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION

SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:
   1. Cast stone.
   2. Clay brick masonry.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's printed statement of VOC content.
   2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For each type of water repellent.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
      a. Size: 10 sq. ft. each.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
   1. Concrete surfaces and mortar have cured for not less than 28 days.
   2. Building has been closed in for not less than 30 days before treating wall assemblies.
   3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
   4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.

5. Rain or snow is not predicted within 24 hours.
6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance: Water repellents shall meet the following performance requirements as determined by manufacturer's standard substrates representing those indicated for this Project.

B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
1. Cast Stone: ASTM C 1195.
2. Clay Brick: ASTM C 67.

C. Water Penetration and Leakage through Masonry: Minimum 80 percent reduction in leakage rate of treated compared to untreated specimens, according to ASTM E 514/E 514M.

2.2 PENETRATING WATER REPELLENTS

A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.

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. BASF Construction Chemicals - Building Systems; Enviroseal 7.
b. Pecora Corporation; KlereSeal 910-W.
c. PROSOCO, Inc.; Siloxane PD.
d. Sika Corporation, Inc.; Sikagard 701W.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations of each material type by method recommended by manufacturer.
2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
3. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

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

3.2 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply coating of water repellent on surfaces to be treated using 15 psi- pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

B. Coverage Test: In the presence of Owner's Representative, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Owner's Representative minimum seven days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 19 00

SECTION 072100 - THERMAL INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Mineral-wool blanket insulation.

B. Related Requirements:

1. 07-54-00 Fully Adhered TPO for insulation specified as part of roofing construction.
2. 07 27 26 Fluid applied air membrane.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.2 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Research Reports: For foam-plastic insulation, from ICC-ES

1.4 DELIVERY, STORAGE, AND HANDLING

A Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

C. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded Polystyrene Board Insulation, Type X: ASTM C578, Type X, 25-psi minimum compressive strength at vertical surfaces, 40-psi minimum compressive strength at underslab locations; unfaced.

1. Manufacturers: Subject to compliance with requirements, provide basis of design products by Dow Chemical Company; Cavity Mate, Styrofoam Brand Square Edge Wide T&G, High Load 60, or similar products by one of the following:
   a. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. MBCI.
   d. Owens Corning.
2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide basis of design product Roxul, Cavity rock, Comfortbatt, or similar products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Rockwool International.
   c. Thermafiber, Inc.; an Owens Corning company.
2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.3 INSULATION FASTENERS

A Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

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:
   a. AGM Industries, Inc.
   b. Gemco
2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

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:
   a. AGM Industries, Inc.
   b. Gemco.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

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:**a**
   a. AGM Industries, Inc.
   b Gemco

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 07 26 00 - VAPOR RETARDERS

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. Polyamide (nylon) vapor retarder.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYAMIDE VAPOR RETARDERS

A. Polyamide Vapor Retarders: Smart vapor retarder, Class A fire rated, 2-mil-thick sheet, with permeance rating of 1 perm or less when tested in accordance with ASTM E96, dry cup method, and greater than 10 perms using wet cup method.

1. Manufacturer: Subject to compliance with requirements, provide products by the following:
   a. CertainTeed Corporation; Membrain Continuous Air barrier & Smart Vapor Retarder.

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on interior side of construction.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 26 00

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 – GENERAL

RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes fluid-applied, vapor-permeable membrane air barriers.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1 Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.01 cfm/sq. ft. of surface area at 75 Pa, when tested according to ASTM E 283or ASTM E 2357.

2.3 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: synthetic polymer membrane.

1. Synthetic Polymer Membrane:

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

1) Carlisle Coatings & Waterproofing Inc.; Barriseal-S.
2) Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.
3) Tremco Incorporated, an RPM company; ExoAir 230.

Dupont; TYVEK Fluid Applied WB

2. Physical and Performance Properties:

a. Vapor Permeance: Minimum 10 perms; ASTM E 96/E 96M.
b. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
c. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Re-prime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip or flashing so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Adhesive-Coated Transition Strip: Roll firmly to enhance adhesion.
2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counter flashings or ending in reglets with termination mastic.

I. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fish mouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Re-prime areas exposed for more than 24 hours.
3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness, applied in two equal coats.

C. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Construction Manager will engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.

2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fish mouths.
8. Strips and transition strips have been firmly adhered to substrate.
9. Compatible materials have been used.
10. Transitions at changes in direction and structural support at gaps have been provided.
11. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
12. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:

1. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

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

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 07 42 13 METAL WALL PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Composite fire-retardant metal panels.

1. Applications of composite fire-retardant metal panels include:

a. Exterior installation of composite metal panels on walls and soffits.

B. Related Sections: Section(s) related to this section include:

1. Sheet Metal Flashing and Trim: Division 07 Flashing and Trim Section.
2. Joint Sealers: Division 07 Joint Treatment Section.
3. Architectural cast stone Division 04.

1.02 REFERENCES

A. ASTM International:

1. ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives.
2. ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics.
3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E108 (Modified) Standard Test Methods for Fire Tests of Roof Coverings.
5. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
6. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
7. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
8. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Wall, and Doors by Uniform Static Air Pressure Difference.

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
2. AAMA 508 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.

C. National Fire Protection Association (NFPA)

1. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide composite metal panels that have been manufactured, fabricated and installed to withstand loads from deflection and thermal movement and to maintain performance criteria stated by manufacturer without defects, damage or failure.

B. Deflection and Thermal Movement: Provide systems that have been tested and certified to conform to the following criteria under wind loading of [specify loading psf (kPa)] inward and [specify loading psf (kPa)] outward:

1. Normal Deflection: Deflection of perimeter framing member not to exceed L/175 normal to plane of the wall; deflection of individual panels not to exceed L/60.

2. Anchor Deflection: At connection points of framing members to anchors, anchor deflection in any direction not to exceed 1/16 inch (1.6 mm).
3. Thermal Movements: Allow for free horizontal and vertical thermal movement due to expansion and contraction of components over a temperature range from [specify temperature range in degrees F (degrees C)].
    a. Buckling, opening of joints, undue stress on fasteners, failure of sealants, or any other detrimental effects of thermal movement will not be permitted.
    b. Fabrication, assembly and erection procedures shall take into account the ambient temperature range at the time of the respective operation.

C. Water and Air Leakage: Provide systems that have been tested and certified to conform to the following criteria:
1. Pressure Equalized Rain Screen Systems.

A. Fire Performance: Provide composite fire rated panels that have been evaluated and are in compliance with regulatory code agency requirements specified herein.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.

B. Product Data: Submit product data, including manufacturer's SPEC-DATA sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures.
1. Include details showing thickness and dimensions of the various system parts, fastening and anchoring methods, locations of joints and gaskets, and location and configuration of joints necessary to accommodate thermal movement.

D. Samples: Submit selection and verification samples for finishes, colors and textures.
1. Selected Samples: Manufacturer's color charts or chips illustrating full range of colors, finishes and patterns available for composite metal panels with factory applied finishes.
2. Verification Samples:
    a. Structural: 12 inches × 12 inches (305 × 305 mm) sample composite panels in thickness specified from an available stock color, including clips, anchors, supports, fasteners, closures and other panel accessories, for assembly approval. Include panel assembly samples not less than 24 inches × 24 inches (610 × 610 mm) showing 4-way joint.
    b. Include separate sets of drawdown samples on aluminum substrate, not less than 3 inches × 5 inches (76 × 127 mm), of each color and finish selected for color approval. Larger samples of standard colors are available with production-applied coatings.

E. Quality Assurance Submittals: Submit the following:
1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties, or a third party listing documenting compliance to a comparable code section.
2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements.
3. Manufacturer's Instructions: Manufacturer's installation instructions.
4. Manufacturer's Field Reports: Manufacturer's field reports.

F. Closeout Submittals: Submit the following:
1. Warranty: Warranty documents specified.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.

a. Certificate: When requested, submit certificate indicating qualification.

2. Manufacturer Qualifications: Company with a minimum of 5 years of continuous experience manufacturing panel material of the type specified:

a. Able to provide specified warranty on finish.

b. Able to provide a list of 5 other projects of similar size, including approximate date of installation and name of Architect for each.

c. Able to produce the composite material without outsourcing of the coating or laminating process.

d. Able to provide a certificate of registration to ISO 9001-2015.

3. Fabricator Qualifications: Company with at least 3 years of experience on similar sized metal panel projects and qualified by panel material manufacturer. Capable of providing field service representation during construction.

B. Regulatory Code Agencies Requirements: Provide composite fire rated panels which have been evaluated and are in compliance with the following:

1. International Code Council (ICC).

C. Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color (drawdown samples to be used for color approval of nonstandard coil coated colors), texture and pattern and workmanship standard. Comply with Division 01 Quality Control, Mock-Up Requirements Section.

1. Mock-Up Size: 4ftx 4ft.

2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.

3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

D. Preinstallation Meetings: Conduct preinstallation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 01 Project Management and Coordination, Project Meetings Section.

1.06 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 01 Product Requirements Sections.

B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

1. Protection: Protect finish of panels by applying heavy-duty removable plastic film during production.

2. Delivery: Package composite wall panels for protection against transportation damage. Provide markings to identify components consistently with drawings.

3. Handling: Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.

1. Storage: Store panels in well-ventilated space out of direct sunlight.

a. Protect panels from moisture and condensation with tarpaulins or other suitable weather tight

covering installed to provide ventilation.

b. Slope panels to ensure positive drainage of any accumulated water.

c. Do not store panels in any enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).

2. Damage: Avoid contact with any other materials that might cause staining, denting or other surface damage.

1.07 PROJECT CONDITIONS

A. Substrate Tolerances: The General Contractor is responsible for providing a substrate with a tolerance of 1/4 inch in 20.0 feet (6mm in 6m), on level, plumb, and location control lines as indicated and within 1/8 inch (3mm) offset of adjoining faces of alignment of matching profiles tolerances are noncumulative.

B. Field Measurements: Verify locations of wall framing members and wall opening dimensions by field measurements prior to fabrication of MCM System. Indicate measurements on the “As Built Shop Drawings”. Field measurements to be taken once all substrate materials and adjacent materials are installed.

C. Project Schedule: Provisions in the project schedule must accommodate the time interval between field measurements and fabrication/installation.

1.08 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

1. Warranty Period:

a. Panel Integrity: 10 years commencing on Date of Substantial Completion.

b. Finish: [Specify number of years] commencing on Date of Substantial Completion.

PART 2 PRODUCTS

Specifier Note: Retain article below for proprietary method specification. Add product attributes, performance characteristics, material standards and descriptions as applicable. Use of such phrases as “or equal” or “or approved equal” or similar phrases may cause ambiguity in specifications. Such phrases require verification (procedural, legal and regulatory) and assignment of responsibility for determining “or equal” products.

2.01 COMPOSITE METAL PANELS

A. Manufacturer: Mitsubishi Chemical America, Inc. ALPOLIC Division

1. Contact: 401 Volvo Parkway, Chesapeake, VA 23320; Telephone (800) 422-7270; Fax: (757) 436-1896; E-mail: info@alpolic.com; website: www.alpolic-americas.com.

B. Proprietary Product: ALPOLIC Composite Metal Panels.

1. ALPOLIC/fr composite fire-retardant metal panels.

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

2.03 COMPOSITE METAL PANEL MATERIALS

A. Composite Metal Panels:

1. Core: Thermoplastic material that meets performance characteristics specified when fabricated into composite assembly.
2. Face Sheets: Aluminum alloy 3105 H14, 0.020 inch (0.51 mm) thick and as follows:
    a. Coil coated with a fluoropolymer paint finish that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.
    b. Coil coated with specified finish [Less than 1000 ft^2 (93 m^2) quantities].
    c. Thermally bonded in a continuous process, under tension, to the core material.
3. Bond Integrity: Tested for resistance to delamination as follows:
    a. Peel Strength (ASTM D1781): 22.5 in-lb/in (100 N-m/m) minimum.
4. Fire Performance:
    a. Flame spread (ASTM E84): Class A (4 and 6 mm).
    b. Smoke Developed (ASTM E84): Class A (4 and 6 mm).
    c. Surface Flammability (Modified ASTM E108): Pass (4 and 6 mm).
    d. Ignition Temperature:
        1) Flash, ASTM D1929: 716 degrees F (380 degrees C).
        2) Ignition: 752 degrees F (400 degrees C).
    e. Flammability, Exterior, Non-load-bearing wall assemblies and panels, NFPA 285: Pass.
5. Product Transparency:
    a. Provide a Product Transparency Declaration (PTD) for the Composite metal panels

B. Production Tolerances:
1. Width: +/- 2 mm.
2. Length: +/- .012” per ft (1 mm/meter).
3. Thickness (4 mm Panel): +/- 0.008 inch (0.2 mm).
4. Thickness (6 mm Panel): +/- 0.012 inch (0.3 mm).
5. Bow: Maximum 0.5% length or width.
6. Squareness: Maximum 0.2 inch (5 mm).
7. Edges of sheets shall be square and trimmed with no displacement of aluminum sheets or protrusion of core material.

C. Panel Thickness: 4 mm

2.04 ACCESSORIES

A. General: Provide fabricator’s standard accessories, including fasteners, clips, anchorage devices and attachments for specific applications indicated on contract documents.

2.05 RELATED MATERIALS

A. General: Refer to other related sections in Related Sections paragraph specified herein for related materials, including cold-form metal framing, flashing and trim, joint sealers, aluminum windows, glass and glazing and curtain walls.

2.06 FABRICATION

A. General: Shop fabricate to sizes and joint configurations indicated on drawings.
1. Where final dimensions cannot be established by field measurements, provide allowance for field adjustment as recommended by the fabricator.

2. Form panel lines, breaks and angles to be sharp and true, with surfaces that are free from warp or buckle.
3. Fabricate with sharply cut edges and no displacement of aluminum sheet or protrusion of core.

2.07 FINISHES

A. Factory Finish: Lumiflon-based fluoropolymer resin coating that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.
1. Color: [TBD].

2.08 SOURCE QUALITY

A. Source Quality: Obtain composite panel products from a single manufacturer.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions.

3.02 EXAMINATION

A. Substrate Tolerances: The General Contractor is responsible for providing a substrate with a tolerance of 1/4 inch in 20.0 feet (6mm in 6m), on level, plumb, and location control lines as indicated and within 1/8 inch (3mm) offset of adjoining faces of alignment of matching profiles tolerances are noncumulative.

B. Field Measurements: Verify locations of wall framing members and wall opening dimensions by field measurements prior to fabrication of MCM System. Indicate measurements on the "As Built Shop Drawings". Field measurements to be taken once all substrate materials and adjacent materials are installed.

C. Project Schedule: Provisions in the project schedule must accommodate the time interval between field measurements and fabrication/installation.

3.03 PREPARATION

A. Surface Preparation: [Specify applicable product preparation requirements for installation of composite metal panels].

3.04 INSTALLATION

A. General:
1. Install panels plumb, level and true in compliance with fabricator's recommendations.
2. Anchor panels securely in place in accordance with fabricator's approved shop drawings.
3. Comply with fabricator's instructions for installation of concealed fasteners and with provisions of Section 07 90 00 for installation of joint sealers.
4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet (6.4 mm in 6.1 m), noncumulative.

B. Related Products Installation Requirements: Refer to other sections in Related Sections paragraph herein for installation of related products.

3.05 FIELD QUALITY REQUIREMENTS

A. Field Quality Control: Comply with panel system fabricator's recommendations and guidelines for field forming of panels.

B. Fabricator's Field Services: Upon Owner's request, provide fabricator's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with fabricator's instructions.
1. Site Visits: [Specify number and duration of periodic site visits].

3.06 ADJUSTING

A. Adjusting:

1. Repair panels with minor damage such that repairs are not discernible at a distance of 10 feet (3 m).
2. Remove and replace panels damaged beyond repair.
3. Remove protective film immediately after installation of joint sealers and immediately prior to completion of composite metal panel work.
4. Remove from project site damaged panels, protective film and other debris attributable to work of this section.

3.07 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

3.08 PROTECTION

A. Protection: Protect installed product's finish surfaces from damage during construction.

1. Institute protective measures as required to ensure that installed panels will not be damaged.

END OF SECTION

Section – 075400- Fully Adhered TPO

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes
1. Thermoplastic Polyolefin Single-Ply Roofing Membrane
2. Thermoplastic Polyolefin Flashings
3. Thermoplastic Polyolefin Accessories
4. Roof Insulation

B. Related Sections
1. Section 06100: Rough Carpentry
2. Section 07620: Sheet Metal Flashing and Trim
3. Section 15430: Plumbing Specialties

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) - *Annual Book of ASTM Standards*
1. ASTM D-751 – Standard Test Methods for Coated Fabrics
2. ASTM D-2137 - Standard Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics
3. ASTM E-96 - Standard Test Methods for Water Vapor Transmission of Materials
4. ASTM D1204 - Standard Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature
5. ASTM D-471 - Standard Test Method for Rubber Property—Effect of Liquids
6. ASTM D-1149 - Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
7. ASTM C-1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
8. ASTM C-1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - *Architectural Sheet Metal Manual*

C. National Roofing Contractors Association (NRCA)

D. American Society of Civil Engineers (ASCE)

E. Factory Mutual (FM Global) - *Approval Guide*

F. Underwriters Laboratories (UL) - *Roofing Systems and Materials Guide* (TGFU R1306)

1.03 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) *Roofing and Waterproofing Manual* for definitions of roofing terms related to this section.

1.04 SUBMITTALS

A. Product Data: Provide product data sheets for each type of product indicated in this section.

B. Shop Drawings: Provide manufacturers standard details and approved shop drawings for the roof system specified.

C. Samples: Provide samples of insulations, fasteners, membrane materials and accessories for verification of quality.

D. Certificates: Installer shall provide written documentation from the manufacturer of their authorization to install the roof system, and eligibility to obtain the warranty specified in this section.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: GAF® shall provide a roofing system that meets or exceeds all criteria listed in this section.

B. Installer's Qualifications:
1. Installer shall be classified as a ***Master or Master Select™*** contractor as defined and certified by GAF®.

C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary roofing manufacturer.

D. Final Inspection: Manufacturer's representative shall provide a comprehensive final inspection after completion of the roof system. All application errors must be addressed, and final punch list completed.

1.06 PRE-INSTALLATION CONFERENCE

A. Prior to scheduled commencement of the roofing installation and associated work, conduct a meeting at the project site with the installer, architect, owner, manufacturer's representative and any other persons directly involved with the performance of the work. The installer shall record conference discussions to include decisions and agreements reached (or disagreements) and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to roofing work.

1.07 PERFORMANCE REQUIREMENTS

A. Provide an installed roofing membrane and base flashing system that does not permit the passage of water and will withstand the design pressures calculated in accordance with the most current revision of ASCE 7.
B. provide all primary roofing materials that are physically and chemically compatible when installed in accordance with manufacturers' current application requirements.

1.08 REGULATORY REQUIREMENTS

A. All work shall be performed in a safe, professional manner, conforming to all federal, state and local codes.

B. Exterior Fire Test Exposure: Provide a roofing system achieving a UL Class ~~A~~ Rating for roof slopes indicated.

C. Windstorm Classification: Provide a roofing system which will achieve a Factory Mutual 1-60 wind uplift rating, as listed in the current FM Approval Guide.

1.09 DELIVERY, STORAGE AND HANDLING

A. Deliver all roofing materials to the site in original containers, with factory seals intact. All products are to carry a GAF® label.

B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range. Reference data sheets for product storage requirements.

C. Do not expose materials to moisture in any form before, during or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.

D. Use “breathable” type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material will be installed.

E. Materials shall be stored above 55°F (12.6°C) a minimum of 24 hours prior to application.

1.10 PROJECT CONDITIONS

A. Weather

1. Proceed with roofing only when existing and forecasted weather conditions permit.
2. Ambient temperatures must be above 45°F (7.2°C) when applying hot asphalt or water-based adhesives.

1.11 WARRANTY/GUARANTEE

Provide Manufacturers standard EverGuard® Diamond Pledge™ Guarantee with single source edge-to-edge coverage and no monetary limitation where the manufacturer agrees to repair or replace components in the roofing system, which cause a leak due to a failure in materials or workmanship.

1. Duration: Twenty (20) years from the date of completion.
   a) Covered components include GAF roofing membrane, liquid-applied membrane or coating, base flashing, high wall waterproofing flashing, insulation, expansion joint covers, preflashed accessories, and metal flashings used by the contractor of record that meet SMACNA standards (the “GAF Roofing Materials”).
   b) Materials and workmanship of listed products within this section are included when installed in accordance with current GAF application and specification requirements. Contact GAF Design Services for the full terms and conditions of the guarantee.
   c) Leaks caused by any non-GAF materials, such as the roof deck, existing materials, or non-GAF insulation are not covered.

PART 2 **PRODUCTS**

2.01 ACCEPTABLE MANUFACTURER

A. GAF® - 1 Campus Drive, Parsippany, NJ 07054
B. For substitutions, submit a PSU substitution request.

2.02 AIR AND VAPOR RETARDER SYSTEM

A. Proprietary formulated elastomeric styrene-butadiene-styrene (SBS) polymer modified bitumen in combination with a high tack self-adhesive, **GAF SA Vapor Retarder** by GAF.

2.03 INSULATION

A. Red List Free certified, holding both an Environmental Product Declaration (EPD) and a Health Product Declaration (HPD) coated glass-fiber bonded to a core of isocyanurate foam meeting the requirements of ASTM D3273 for resistance to mold growth, **EnergyGuard™ Barrier Polyiso Roof Insulation** by GAF®.
B. Should meet requirements in section 072100 - thermal insulation as follows
   1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
   2 Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
   3 Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
   2. Board Thickness: 2 layers 2.6” Total 5.2”
   3. Thermal Resistance (LTTR value) of each layer R15. Total R30
   4. Compressive Strength: 20 PSI, meets ASTM C1289, Type II, Class 1, Grade 2.

2.04 COVER BOARD

A. Fiber-reinforced gypsum panel with an integral water-resistant core. Securock® Gypsum Fiber Roof Board by US Gypsum.
   1. Board Thickness: ¼”
   2. Board Size: 4’ x 8’
   3. Thermal Resistance (R value) of: .20

2.05 MEMBRANE MATERIALS

A. A smooth type, polyester scrim reinforced thermoplastic polyolefin membrane, for use as a single ply roofing membrane. Meets or exceeds the minimum requirements of ASTM D-6878. UL Listed, FM Approved, Dade County Product Approval, Florida Building Code Approved.
   1. **EverGuard® TPO;**
      a) Thickness: 60mil
      b) Color: Energy Gray - Energy Star Listed, CRRC Listed and Title 24 Compliant.

2.06 FLASHING MATERIALS

A. Advanced heat and UV protected, smooth type, polyester scrim reinforced thermoplastic polyolefin membrane, for use as a single ply roofing membrane. Meets or exceeds the minimum requirements of ASTM D-6878. UL Listed, FM Approved, Dade County Product Approval, Florida Building Code Approved.
   1. **EverGuard® TPO**
      a) Thickness: 60mil

b) Color: Energy Gray - Energy Star Listed, CRRC Listed and Title 24 Compliant.

2.07 ADHESIVES, SEALANTS and PRIMERS

A. Low VOC Sprayable solvent-based adhesive for smooth TPO: **EverGuard® TPO Quick Spray Adhesive LV50**, by GAF®.

B. Two-part low rise polyurethane foam adhesive for use with insulation and fleece-back membranes, **Oly-Bond 500™ Roofing Adhesive - Equipment-Free Canister** by GAF®.

C. Low VOC solvent based primer for preparing surfaces to receive butyl based adhesive tapes, **EverGuard® TPO Low VOC Primer**, by GAF®.

D. Low VOC solvent based cleaner used to clean exposed or contaminated seam prior to heat-welding or priming, **EverGuard® CleanWeld™ Conditioner,** by GAF®.

E. One-part moisture cure, self-leveling sealant designed for use in pitch pans **EverGuard® One-Part Pourable Sealer** by GAF®.

F. One part butyl based high viscosity sealant suitable for sealing between flashing membrane and substrate surface behind exposed termination bars and for sealing between roofing membrane and drain flange. **EverGuard® Water Block**, by GAF®.

2.08 PLATES & FASTENERS

A. **Drill•Tec™ HD Screws**: Heavy gauge alloy steel fastener with CR-10 coating with a .245" diameter thread. Miami Dade and Factory Mutual Standard 4470 Approved, #3 Phillips truss head for use on wood, concrete and steel decks.
B. **Drill•Tec™ Insulation Plates**: Galvalume, 3" (76 mm) diameter, suitable for use with Drill•Tec™ Standard and HD screws, and Drill•Tec™ Spikes. Special design available for use with Drill•Tec™ Polymer Screws.

2.09 NAILS & SPIKES

A. **DRILL-TEC™ Masonry Anchor:** Zinc alloy anchor with stainless steel or zinc plated steel pin available in either 1/4" or 3/16" diameter. Designed to attach termination bars to concrete or masonry walls.

2.10 ACCESSORIES

A. GENERAL FLASHING ACCESSORIES
1. A smooth type, unreinforced thermoplastic polyolefin based membrane for use as an alternative flashing/reinforcing material for penetrations and corners. Required whenever preformed vent boots cannot be used, 0.055 inches (55 mils) nominal thickness and sheet size: 24in x 50ft. **EverGuard® TPO UN-55 Detailing Membrane**, by GAF.

2. An 8 inch (20 cm) wide smooth type, polyester scrim reinforced thermoplastic polyolefin membrane strip for use as a cover strip over coated metal and stripping-in coated metal flanges and general repairs: 0.045 inches (45 mils) nominal thickness with 100 foot length, **EverGuard® TPO 45 Mil Utility Flashing Membrane**, by GAF.

3. 24 gauge steel with 0.025" thick TPO based film as required for fabrication into metal gravel stop and drip edge profiles, metal base and curb flashings, sealant pans, and scupper sleeves. Standard sheet size 4' x 10', sheet weight 47 lbs. Custom sizes available, **EverGuard® TPO Coated Metal**, by GAF.

4. Extruded aluminum termination bar with angled lip caulk receiver and lower leg bulb stiffener. Pre-punched slotted holes at 6" on center or 8" on center. ¾" x 10' with 0.090" cross section, **DRILL-TEC™ Termination Bar,** by GAF.

5. Pre-manufactured expansion joint covers used to bridge expansion joint openings in a roof structure. Fabricated to accommodate all roof to wall and roof to roof applications, made of .060" reinforced TPO membrane, available in 5 standard sizes for expansion joint openings up to 8" wide. **EverGuard® TPO Expansion Joint Covers,** by GAF

6. .055" thick smooth type, unreinforced thermoplastic polyolefin membrane designed for use as a conforming membrane seal over T-joints in 60 and 80 mil membrane applications. **EverGuard® T-Joint Patches**, by GAF.

B. ROOF EDGE ACCESSORIES

1. A 6 inch (14 cm) wide, smooth type, heat-weldable polyester scrim reinforced thermoplastic polyolefin membrane strip. Designed for use as a cover strip over non-coated metal edges and flanges. Each full roll contains approximately 100 Lineal Ft. of material, 6" X 100'. **EverGuard® TPO Heat-Weld Cover Tape**, by GAF.

C. WALL & CURB ACCESSORIES

1. .045" reinforced TPO membrane with pressure sensitive adhesive, to be installed on horizontal surfaces using plates and fasteners as a base attachment in adhered systems. Size 6" x 100', EverGuard® RTA (Roof Transition Anchor) Strip™, by GAF

2. 55 mil TPO membrane and 24 gauge coated metal prefabricated into standard and custom size thru wall scuppers**.** Available in two sizes: 4" x 6" x 12" (l x w x d) with a 5.75" x 3.75" opening and 8" x 10" x 12" (l x w x d) with a 9.75" x 7.75" opening, **EverGuard® TPO Scupper,** by GAF

3. .045" or .060" thick reinforced TPO membrane fabricated corners. Available in four standard sizes to flash curbs that are 24", 36", 48", and 60" in size. Four corners are required to flash the curb, **EverGuard® Corner Curb Wraps,** by GAF.

4. 0.060" thick molded TPO membrane outside corners of base and curb flashing. Hot-air welds directly to EverGuard® TPO membrane. Size 4" x 4" with 6" flange, **EverGuard® TPO Universal Corners** by GAF.

5. 0.055" molded TPO membrane inside corners of base and curb flashing. Hot-air welds directly to EverGuard TPO membrane. Size 6" x 6" x 5.5" high **EverGuard® TPO Preformed Corners** by GAF.

6. 8” diameter, nominal .050” vacuum formed unreinforced TPO membrane for use in flashing outside corners of base and curb flashings, **EverGuard® TPO Fluted Corner**, by GAF.

D. PENETRATION ACCESSORIES

1. 0.075” thick molded TPO membrane sized to accommodate most common pipe and conduits, (1” to 6” diameter pipes), including square tube. Hot-air welded directly to EverGuard TPO membrane, supplied with stainless steel clamping rings, **EverGuard® TPO Preformed Vent Boots** by GAF.

2. 0.045” thick molded TPO membrane preformed boots are split to accommodate most common pipes and conduits and available in three standard sizes, **EverGuard® TPO Split Pipe Boots**, by GAF.

3. 0.045” thick molded TPO membrane preformed square boots are split to accommodate most common square penetrations and conduits and available in three standard sizes, **EverGuard® TPO Square Tube Wraps**, by GAF.

4. .070 thick molded penetration pocket to provide structure and foundation for the application of a pourable sealant for a variety of roof penetrations, weldable and 9" x 6" x 4" (l x w x h). **EverGuard® TPO Pourable Sealer Pocket**

5. Constructed from spun aluminum and preflashed using .055” thick smooth type, unreinforced thermoplastic polyolefin membrane. Available in a wide range of sizes to allow a proper fit into any size roofing drain. **EverGuard® TPO Drain** by GAF

6. Aluminum drain unit coated with a weldable TPO compound. TPO membrane can be heat welded directly to the drain body, resulting in a strong, secure installation. Each drain is fitted with a BlueSeal® mechanical drain seal for a secure, tight seal into the building drain system. Available in two sizes (3” and 4”), and custom sizes are available. **EverGuard® TPO Coated Metal Drain** by GAF

E. WALKWAYS

1. 1/8” thick extruded and embossed TPO roll 34.25” x 50’, heat welds directly to roofing membrane. Unique “diamond tread” traction surface and features a 2” (51 mm) welding strip (smooth border) along each longitudinal edge that is compatible with hand or automatic welders. Available in gray or safety yellow, **EverGuard® TPO Walkway Rolls**, GAF.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that the surfaces and site conditions are ready to receive work.

B. Verify that the deck is supported and secured.

C. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters.

D. Verify that the deck surfaces are dry and free of ice or snow.

E. Verify that all roof openings or penetrations through the roof are solidly set, and that all flashings are tapered.

3.02 SUBSTRATE PREPARATION

A. Plywood Deck
1. Plywood sheathing must be exterior grade, minimum 4 ply, and not less than 3/4” (19 mm) 19/32” (Miami Dade County) thick.
2. Preservatives or fire retardants used to treat the decking must be compatible with roofing materials.
3. The deck must be installed so that all four sides of each panel bear on and are secured to joist and cross blocking. The panels must be secured in accordance with APA–The Engineered Wood Association recommendations “H” clips are not acceptable.
4. Panels must be installed with a 1/8” to 1/4” (3mm – 6mm) gap between panels and must match vertically at joints to within 1/8” (3mm).
5. Decking should be kept dry and roofed promptly after installation.
6. Deck shall be attached with approved fasteners at required spacing. Consult local building codes for specific requirements.

3.02 NAILER INSTALLATION

A. Acceptable Material
1. Solid Blocking: Non-pressure treated wood as required, #2 Grade or better, nominal 1 1 /4" (30 mm) x 4" (102 mm) with a minimum thickness of 3 1 /2" (88 mm).
2. Shim Material: Plywood, 1 /2" (13 mm) x width to match solid blocking.
3. Verify the condition of existing roof nailers and anchor to resist 250 lb. per ft. (550 kg) load applied in any direction. New nailers should meet same load requirements.
4. DRILL-TEC™ HD screws 18" (457 mm) o.c. attachment to structural wood, steel decks with a 1" (25 mm) thread embedment.
5. DRILL-TEC™ spikes or HD screws 18" (457 mm) o.c. attachment to concrete decks. Min. 1" (25 mm) shank or thread penetration.
6. Wood nailers attached to gypsum, concrete, cellular concrete and cementitious wood fiber must be fastened 12" (305 mm) o.c., through the nailer into the substrate with substrate approved DRILL-TEC™ fasteners.
7. Three anchors per length of wood nailer minimum.

B. Metal Blocking
1. 20 Ga. galvanized steel box with pre-punched holes and supplied with corrosion-resistant fasteners.
2. Closure and finish strip required for metal decking.
3. Secure in place using provided #14 x 1½-in. universal fasteners through pre-punched holes to roof edge.
4. Install end cap and top of box section with #14 x 1½-in. universal fasteners.

3.03 INSTALLATION – GENERAL

A. Install GAF®'s EverGuard® TPO roofing system according to all current application requirements in addition to those listed in this section.

B. GAF® EverGuard® TPO Specification #:

C. Start the application of membrane plies at the low point of the roof or at the drains, so that the flow of water is over or parallel to, but never against the laps.

3.04 AIR/VAPOR BARRIER

A. GENERAL
1. Air/vapor retarder components must typically be installed when required by design professional to address internal building air pressure or humidity conditions on the structural deck or directly over a minimal layer of EnergyGuard™ insulation or fire barrier.
2. EnergyGuard™ insulation must be installed over the vapor retarder to raise the location of the dew point temperature above the level of the vapor retarder.
3. Designers should consider requiring air retarders:
   a) On all air porous decks, with openings in the walls or area directly below the roof deck that exceeds 10% of the total wall area.
   b) When the internal pressurization of the building is in excess of 5 lbs. per sq. ft. (239 Pa).
   c) When buildings have large openings or overhangs.
   d) In conditions where positive internal pressure is applied suddenly, as may be the case at aircraft hangers or distribution centers—otherwise, the roofing system may fail due to pressure impact.
4. Refer to FM Global Loss Prevention Data Sheets 1-28 and 1-29 for specific installation procedures for all roofs with large openings.
5. For roofs to be guaranteed by GAF:
   a) Air retarders are required for all extended-length guarantees on buildings where large wall openings greater than 10% of the total wall area can be open during a windstorm, including opening due to storm damage.

B. APPLICATION – ADHERED
1. Apply compatible adhesive to the structural deck or fire barrier board per air vapor retarder manufacturers' recommendations.
2. Install the air/vapor retarder components loose applied to the deck or fire barrier board so that wrinkles and buckles are not formed. Broom air/vapor barrier components to ensure embedment into the adhesive.
3. Overlap air/vapor retarder components a minimum of 6" (152 mm) for side and end laps. Adhere laps together with compatible adhesive.
4. Seal perimeter and penetration areas with foam sealant.
5. Install insulation boards over the air/vapor barrier and mechanically attach the boards to the deck or adhere the boards to the air/vapor retarder with compatible adhesive to achieve the desired roof system uplift resistance.
6. A continuous vapor seal is essential around roof edges, parapets, roof-to-wall transitions, and directly above interior dividers/partitions separating between cold and warmer controlled environments.
7. Where applicable, ensure the insulated wall panel cap is set in EverGuard® Water Block Sealant and secured to the wall panel at 6" on center maximum.
8. Fill panel lows with trowel grade polyurethane sealant to achieve a level, smooth surface approximately 4" to 6" from the top of the panel.
9. Secure cured membrane flashing through the area of the panel that was leveled using generous application of EverGuard® Water-Block Sealant and the DRILL-TEC™ Termination Bar fastened to achieve constant compression against the panel.

10. The transition vapor seal can be completed by turning the cured flashing over the roofing membrane setting each layer in generous beads of EverGuard® Water-Block Sealant as outlined in the applicable GAF detail.

3.04 INSULATION

A. GENERAL

1. Do not apply roof insulation or roofing until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment. A vapor retarder coated lightly with asphalt may be applied to protect the inside of the structure prior to the insulation and final roofing installation. Before the application of the insulation, any damage or deterioration to the vapor retarder must be repaired.
2. Do not install wet, damaged or warped insulation boards.
3. Install insulation boards with staggered board joints in one direction (unless taping joint).
4. Install insulation boards snug. Gaps between board joints must not exceed ¼" (6 mm). All gaps in excess of ¼" (6 mm) must be filled with like insulation material.
5. Wood nailers must be 3-1/2" (89 mm) minimum width or 1" (25.4 mm) wider than metal flange. They shall be of equal thickness as the insulation, and be treated for rot resistance. All nailers must be securely fastened to the deck.
6. Do not kick insulation boards into place.
7. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.
8. Roof tape, if required over insulation joints, must be laid evenly, smoothly and embedded in a uniform coating of hot steep asphalt with 4" (102 mm) end laps. Care must be taken to assure smooth application of tape, and full embedment of the tape in the asphalt.
9. Do not install any more insulation than will be completely waterproofed each day.

B. INSULATION APPLICATION

1. The insulation must be securely attached to the roof deck. A minimum FMRC 1-60 attachment is recommended. Refer to FMRC Approval Guide for FM fastening patterns. Factory Mutual requires fastener density increased in corner areas for FM 1-60 as well as perimeter and corner area fastener density increases for FM 1-90 or greater. Refer to FM Loss Prevention Data Sheets 1-7, 1-28, and 1-49.
2. Apply LRF O Adhesive directly to the substrate using a ribbon pattern. Space beads as required by job specification, typically 6" or 12" (152 mm or 305 mm) o.c.
3. LRF O Adhesive should be approximately 70°F (22°C) when being dispensed. As adhesive is applied, allow the adhesive to begin rising, then place board.
4. The substrate must be free of and debris, dust, dirt, oil, grease, and standing water before applying the adhesive.
5. OlyBond 500 must be applied using the specially designed PaceCart dispenser. OlyBond 500 SpotShot shall be applied using one of the specially designed dual cartridge dispensers.
6. Install insulation layers applied with bands of OlyBond 500 spaced 12" o.c. Approximate coverage rate is ½ to 1 gallon per 100 square feet, depending on the substrate. Allow the foam to rise ¾" to 1" (25.4 mm). Walk each board firmly into place. Stagger the joints of additional layers in relation to the insulation joints in the layer(s) below by a minimum of 6" (152 mm) to eliminate continuous vertical gaps.
7. The substrate must be free of debris, dust, dirt, oil, grease, and standing water before applying the adhesive.

8. Install insulation layers applied with 3/4” beads of Insta-Stik spaced 12” o.c. Press each board firmly into place. Stagger the joints of additional layers in relation to the insulation joints in the layer(s) below by a minimum of 6” (152 mm) to eliminate continuous vertical gaps.
9. Loose apply the base layer of insulation for subsequent layers to be simultaneously attached or for ballast applications. Minimal fastening should be performed to avoid movement of the boards.
10. Fill all flutes with a loose applied base layer of insulation. Insulation must be of equal height as metal ribs, seams or flutes to allow for subsequent layers to be applied without interference. Minimal fastening should be performed to avoid movement of the boards.
11. If subsequent layers of insulation are to be attached with insulation adhesive, the base layer must be mechanically attached with a minimum fastener density of 1 fastener every 2 square feet.

3.01 MEMBRANE APPLICATION

A. GENERAL

1. Substrates must be inspected and accepted by the contractor as suitable to receive and hold roof membrane materials.
2. Place roof membrane so that wrinkles and buckles are not formed. Any wrinkles or buckles must be removed from the sheet prior to permanent securement.
3. Membrane that has been exposed for more than 12 hours or has become contaminated will require additional cleaning methods.
   a) Light Contamination - Membrane that has been exposed overnight up to a few days to debris, foot traffic, or dew or light precipitation can usually be cleaned with a white cloth moistened with EverGuard® TPO Cleaner (or EverGuard® CleanWeld™ Conditioner, a low-VOC cleaner) for TPO membranes.
   b) Dirt-Based Contamination - Membrane that is dirt encrusted will require the use of a low-residue cleaner, such as Formula 409® and a mildly abrasive scrubbing pad to remove the dirt. This must be followed by cleaning with a white cloth moistened with EverGuard® TPO Cleaner (or EverGuard® CleanWeld™ Conditioner) for TPO membranes. Be sure to wait for solvent to flash off prior to welding.
   c) Exposure-Based Contamination - Membrane that is weathered or oxidized will require the use of EverGuard® TPO Cleaner, EverGuard® CleanWeld™ Conditioner, and a mildly abrasive scrubbing pad to remove the weathered/oxidized top surface layer. This must be followed by cleaning with a white cloth moistened with EverGuard® TPO Cleaner (or EverGuard® CleanWeld™ Conditioner) for TPO membranes. Unexposed membrane left in inventory for a year or more may need to be cleaned as instructed above. Be sure to wait for solvent to flash off prior to welding.
   d) Chemical-Based Contamination - Membrane that is contaminated with bonding adhesive, asphalt, flashing cement, grease and oil, and most other contaminants usually cannot be cleaned sufficiently to allow an adequate heat weld to the membrane surface. These membranes should be removed and replaced.

A. FULLY ADHERED

1. All work surfaces should be clean, dry, and free of dirt, dust, debris, oils, loose and/or embedded gravel, un-adhered coatings, deteriorated membrane, and other contaminants that may result in a surface that is not sound or is uneven.
2. Full-width rolls can be installed throughout the field and perimeter of the roof. Half sheets are not necessary.

3. Overlap roof membrane a minimum of 3" (76 mm) for end laps. For fleece-back membrane, butt ends together and cover joint with 8” (203 mm) wide EverGuard Flashing Strip heat-welded. Membranes are provided with lap lines along the side laps.
4. Best practice is to install membrane so that the side laps run across the roof slope lapped toward drainage points.
5. All exposed sheet corners must be rounded a minimum of 1" (25 mm).
6. Use full-width rolls throughout the field and perimeter of the roof. Half sheets are not necessary.
7. Membrane laps shall be heat-welded together. All welds shall be continuous, without voids or partial welds. Welds shall be free of burns and scorch marks.
8. Weld shall be a minimum of 1” (25.4 mm) in width for automatic machine welding and a minimum 2” in width for hand welding,
9. Roof membrane must be mechanically attached along the base of walls with screws and plates 6” (152 mm) on center.
10. Adhesives should be applied to membrane at the rates listed on the pail.
11. Use appropriate bonding adhesive for substrate surface, applied with a solvent-resistant roller, brush or squeegee
12. Adhere approximately one half of the membrane sheet at a time. One half of the sheet's length shall be folded back in turn to allow for adhesive application. Lay membrane into adhesive once the bonding adhesive is tacky to the touch.
13. Roll membrane with a weighted roller to ensure complete bonding between adhesive and membrane.
14. Prevent seam contamination by keeping the adhesive application a few inches back from the seam area.
15. Reference the Adhesive securement tables in the *EverGuard® Application and Specifications Manuals* for substrate adhesion and compatibility.
16. Apply LRF Adhesive directly to the substrate using a ribbon pattern. Space beads as required by job specification, typically 6” or 12” (152 mm or 305 mm) o.c.
17. Apply low rise foam in canisters should be applied in “spatter method” for fleece-back membrane applications ONLY.
18. Roll in membrane using a 150 lb. membrane roller or equivalent.

3.02 FLASHINGS

A. GENERAL

1. All penetrations must be at least 24” (61 cm) from curbs, walls, and edges to provide adequate space for proper flashing.
2. Flash all perimeter, curb, and penetration conditions with coated metal, membrane flashing, and flashing accessories as appropriate to the site condition.
3. All coated metal and membrane flashing corners shall be reinforced with preformed corners or non-reinforced membrane.
4. Hot-air weld all flashing membranes, accessories, and coated metal. A minimum 2” wide (hand welder) weld or minimum 1 - 1/2" automatic machine weld is required.
5. Non-coated metal edge details must be installed in accordance with current EverGuard® construction details and requirements.
6. All twenty (20) year EverGuard® systems require the use of coated metal edges where applicable. Bonding adhesive and/or cover tape is not acceptable.
7. All cut edges of reinforced membrane must be sealed with EverGuard® TPO Cut Edge Sealant.

8. EverGuard Extreme® flashings and accessories are required for use with EverGuard Extreme® membranes.
9. Consult the EverGuard® Application and Specifications Manual or GAF Contractor Services for more information on specific construction details.

B. WOOD SUPPORT BLOCKING
1. Wood support blocking, typically 4" x 4" (102 mm x 102 mm), is usually installed under light-duty or temporary roof-mounted equipment, such as electrical conduit, gas lines, condensation and drain lines.
2. Install wood support blocking over a protective layer of EverGuard® TPO walkway rolls or PVC walkway pads. Place wood blocking on oversized slip sheet, fold two sides vertically, and fasten with roofing nails into the blocking.

3.03 TRAFFIC PROTECTION

A. Install walkway pads at all roof access locations and other designated locations including roof-mounted equipment work locations and areas of repeated rooftop traffic.

B. Walkway rolls or pads must be spaced 6" (152 mm) apart to allow for drainage between the pads.

C. Heat-weld walkway rolls or pads to the roof membrane surface continuously around the perimeter of the pad/roll.

3.04 ROOF PROTECTION

A. Protect all partially and fully completed roofing work from other trades until completion.

B. Whenever possible, stage materials in such a manner that foot traffic is minimized over completed roof areas.

C. When it is not possible to stage materials away from locations where partial or complete installation has taken place, temporary walkways and platforms shall be installed in order to protect all completed roof areas from traffic and point loading during the application process.

D. Temporary tie-ins shall be installed at the end of each workday and removed prior to commencement of work the following day.

3.05 CLEAN-UP

A. All work areas are to be kept clean, clear and free of debris at all times.

B. Do not allow trash, waste, or debris to collect on the roof. These items shall be removed from the roof on a daily basis.

C. All tools and unused materials must be collected at the end of each workday and stored properly off of the finished roof surface and protected from exposure to the elements.

D. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.

E. Properly clean the finished roof surface after completion, and make sure the drains and gutters are not clogged.

F. Clean and restore all damaged surfaces to their original condition.

3.06 MAINTENANCE

A. Inspections to the roof shall be performed annually by a GAF® **Master Select™** contractor.

B. An annual roofing system maintenance program shall be performed by a Master **Select™** contractor in accordance with GAF®'s 10 Point Maintenance Program provided with your Diamond Pledge™ guarantee.

C. Submit copies of the roof inspection form, accompanying photographs (a minimum of 6 photos showing the condition of the roof and critical details), and a record of all roofing system maintenance to the GAF® Technical Support Services Department within sixty (60) days of the anniversary date of the completion of the roofing system. Annual roof inspections must be started within the first two (2) years of the guaranteed term.

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07-54-00 FULLY ADHERED TPO materials and installation of sheet metal flashing and trim integral with roofing.
3. FM Global Manual Requirements

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.

4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 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 manufactured product and accessory.

B. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority ,having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

Sample Warranty: For special warranty

FM Global- adherence documents

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are FM approved, shop shall be listed as able to fabricate required details as tested and approved.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class-190. Identify materials with name of fabricator and design approved by FM Approvals.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
1. Exposed Coil-Coated Finish:
a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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 for seacoast and severe environments.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

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. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
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-Tin Alloy-Coated Copper sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel

C. Solder:

1. For Zinc-Tin Alloy-Coated Stainless Steel: ASTM B 32, 100 percent tin, with maximum lead content of 0.2 percent, as recommended by sheet metal manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. 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.

I. Do not use graphite pencils to mark metal surfaces.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof and Roof-to-Wall Transition Expansion-Joint Cover: Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

B. Base Flashing: Fabricate from the following materials:
   1. Aluminum: 0.040 inch thick.

C. Counterflashing: Fabricate from the following materials:
   1. Aluminum: 0.032 inch thick.

D. Flashing Receivers: Fabricate from the following materials:
   1. Aluminum: 0.032 inch thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

F. Roof-Drain Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 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. Use fasteners, 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, levels, and slopes. 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. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches ; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not pre-tin zinc-tin alloy-coated stainless steel.
2. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

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 cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at spacing recommended by manufacturer.

C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

D. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

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 minimum of 4 inches . Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Butyl joint sealants.
6. Latex joint sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

D. Field-Adhesion-Test Reports: For each sealant application tested.

E. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with cast stone and masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where easily observable.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
4. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD 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 or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Installer's Warranty: 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: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, 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.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

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. Dow Corning Corporation; 791.
   b. GE Construction Sealants; Momentive Performance Materials Inc; SCS2000 SilPruf.
   c. Pecora Corporation; PCS.
   d. Sika Corporation U.S.; Sikasil WS-295.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

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. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. Pecora Corporation.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.

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. BASF Construction Chemicals - Building Systems; Sonolastic SL 1.
   b. Pecora Corporation; NR-201.
   c. Sherwin-Williams Company (The); Stampede 1SL.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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. Dow Corning Corporation; 786-M White.
   b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
   c. Tremco Incorporated; Tremsil 200.

2.6 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

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. Bostik, Inc.; Chem-Calk 300.
   b. Pecora Corporation; BC-158.

2.7 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

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. BASF Construction Chemicals - Building Systems; Sonolac.
   b. Pecora Corporation; AC-20.
   c. Sherwin-Williams Company (The).

2.8 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers, and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 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, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to

promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

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 performance of the Work.

B. 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 and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. 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. Nonporous joint substrates include the following:
    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

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.

3.3 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 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.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. 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.

F. 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.
4. Provide flush joint profile at according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and according to Figure 8C in ASTM C 1193.
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
    a. Perform 2 tests for joint length for each kind of sealant and joint substrate.
    b. Perform one test for each joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether

joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. 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.

3.6 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
    a. Construction joints in cast-in-place concrete.
    b. Control and expansion joints in unit masonry.
    c. Joints between metal panels.
    d. Joints between different materials listed above.
    e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
    a. Isolation joints in cast-in-place concrete slabs.
    b. Control and expansion joints in tile flooring.
2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:
    a. Control joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Concealed mastics.
   1. Joint Locations:
      a. Aluminum thresholds.
      b. Sill plates.
   2. Joint Sealant: Butyl-rubber based.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00

SECTION 08 11 16- ALUMINUM THERMAL FLUSH DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cross Aluminum Flush Doors.

B. Aluminum Door Frames

1.02 RELATED SECTIONS

A. Section 04 20 00: Masonry (Frame Installation)

B. Section 07 92 00: Joint Sealers

C. Section 08 71 00: Door Hardware

1.03 REFERENCES

A. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM B 221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. ASTM B 308 - Aluminum-Alloy 6061-T6 Standard Structural Profiles.

D. ASTM E 283 - Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

E. ASTM E 330 - Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

F. ASTM E 331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

G. ASTM E 1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

H. ASTM E 1996 – Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

1.04 SYSTEM DESCRIPTION

A. System Performance Requirements:

1. Air infiltration: When tested in accordance with ASTM E 283, the air infiltration should not exceed .04 cfm per square foot of fixed area.

2. Water Penetration: No water will pass through the entry system when tested in accordance with ASTM E 331 at a pressure of 6.24.

3. Uniform Load Deflection: Entry system shall be tested in accordance with ASTM E 330: 3840 Pa or 80.0 psf positive and negative.

4. Uniform Load Structural: Entry system shall be tested in accordance with ASTM E 330: 5760 Pa or 120.0 psf positive and negative.

5. Missile Impact: Entry system will pass double impact from large missile; ASTM E 1886.

1.05 SUBMITTALS

A. General: Refer to Submittal Procedures – Section 01 33 00

B. Product Data: Include manufacturer's product information, including material, elemental construction, fabrication, and finishes.

C. Shop Drawings: Include shop drawings relating to dimensions, fabrication, finish and installation.
   1. Drawings should include the following:
      a. Dimensions
      b. Elevations with necessary detail keys
      c. Entry system reinforcements (if applicable)
      d. Fabrication and Finish

D. Samples:
   1. Color: Provide manufacturer's samples of standard and non-standard finishes.
   2. Door: Supply manufacturer's door sample presenting finish, interior insulation, and standard reinforcement components.

E. Test Results: Offer any required test results for particular jobs. Accredited test reports will be available upon request.

F. Manufacturer's Instructions: Provide all necessary instructions for installation including glazing, anchoring, reinforcement (if applicable), and optimum performance installation.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturing process with contemporary inspection using neoteric checklist for optimum field performance.
   2. Manufacturing same product specified for over 25 years.

B. Pre-Installation Meetings: Plan initial pre-installation meetings for job details and regional regulations.

1.07 DELIVERY, STORAGE, HANDLING

A. Packing: Finished products shall be packaged securely with appropriate labeling for protection and product identification visible on packaging.

B. Shipping and Handling: Deliver materials to site in original condition and packaging without any damage to packaging or materials.

C. Unloading: Individually packaged products to be unloaded by hand truck or 2-person team lift (or more if needed) to avoid unnecessary damage.

D. Storage and Protection:
1. Store items indoors away from excessive amounts of moisture.
2. Protect entry doors against damage from outdoor hazards and during the entire installation

E. Waste Management: Refer to contact information apparent on packaging for appropriate recycling opportunities.

1.08 WARRANTY

A. Warrant doors and frames to be free from defects and premature degradation of finish and door structure.

B. Warranty period will be ten years from the date of manufacture.

PART 2 PRODUCTS

2.01 MANUFACTURER

Subject to compliance with requirements, provide basis of design products by Cross Aluminum Products, FLT-400 Series with required aluminum frames. Web: www.crossaluminum.com. Email: door@crossaluminum.com or similar products by one of the following:

A. CMI Architectural
B. EFCO Corporation.
C. Kawneer North America, an Arconic company

2.02 THERMAL ALUMINUM FLUSH DOORS

A. Product: basis of design FLT-400 Series with required aluminum frames.

B. Door Opening Size: [refer to drawings]

C. Door Assembly:
1. Door Stile: To be aluminum alloy 6063; temper to be T5 with a minimum 1/8" wall thickness.
2. Stile Thickness: To be 1 3/4" thick tubular extrusion.
3. Door Joinery: Joinery shall be 3/8" diameter zinc plated tie rods bolted through interlocking stiles. Minimum of 3 tie rods per door (where applicable).

4. Top of Door: To receive added 1/8” reinforcement closer plate adhered to interior wall for door closer hardware.
5. Top/Bottom of Door: To receive 1/8” thick cap for further seal and to trim the top and bottom of door.

D. Pattern:
1. Inside Door Face[Fluted] or [Smooth]
2. Outside Door Face [Fluted] or [Smooth

E. Insulation: Polyisocyanurate Rigid Foam

2.03 MATERIALS & ACCESSORIES

A. Aluminum:
1. ASTM B 221, alloy and temper to be 6063 T-5 or similar alloy and temper recommended by manufacturer for optimum finish results and consistency.

B. Internal Reinforcement
1. ASTM B 308, for structural aluminum.

C. Fasteners
1. Material: Aluminum, 18-8 Stainless Steel, or other non-corrosive materials compatible with items being screw applied.
2. Exposed:
   a. Type: Fasteners exposed will be Philips flathead fasteners unless provided by other supplier.
   b. Finish: Fasteners to match appropriate finish on standard doors and frames.
3. Concealed: To be standard according to manufacturer’s standards.

D. Weather stripping:
1. Wool pile:
   a. Material: Solid Propylene Base with resilient fibers.
   b. Color: Manufacturer’s standard black color.

C Thermal Bar:
1. Thermal I-Strut. Mechanically attached to thermally Break Tubular extrusions:
   a. Material to be Polyamide 6.6 with 25% glass fibers
   b. Color: manufacturer’s standard black color

2.04 HARDWARE

A. Hardware Preparation: To be fabricated at factory according to hardware templates provided.

B. Hardware Installation: To factory install all applicable and supplied hardware to doors and frames.

C. Hardware Reinforcement: To provide necessary reinforcement for proper longevity and hardware function; ASTM B 209 and/or ASTM 308.

D. Hardware types:
1. Butt Hinges
2 Continuous Gear Hinges
3. Pivot Hinges
4. Closers
6 Concealed Overhead Stops
7. Push Bars
8. Panic Exit Devices
9. Pull Handles
10. Mortise Locks
11. Manual Flush Bolts
12. Cylindrical Locks
13. Dead Locks
14. Electric Power Transfer
15. Electric Strikes
16. Position Switches
17. Kick Plates
18. Door Sweeps
19. Thresholds
20. Other

E. Hardware Finish: See Hardware Schedule

2.05 FABRICATION

A. Processes:
1. Job Preparation:
a. Preliminary Analysis: Job drawings to indicate door types, sizes, vision lite configuration(s), and finishes.
b. Fulfill Custom Requirements: Follow through on any specific deviations from standard requirements.

2. Assembly:
a. Product Operation: Measure, cut, and fabricate required materials for designated job.
b. Product Refinement: Smooth rough cut edges.
c. Arrangement: Place prepared structural fasteners inside door to conceal from view.
d. Reinforcement Preparation: To apply necessary structural and hardware reinforcement in beneficial areas of doors and frames where needed.

3. Fitting:
a. Placement: Product materials to fit accurately in appropriate locations.
b. Alignment: Doors to be in proper alignment with intended elevations.

B. Tolerances: Doors and/or frame elevations will not deviate from last revised and approved drawings.

2.06 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard aluminum extruded profiles with required thickness for load support.
   1. Vertical Jamb Sizes: [1 3/4" x 4 1/2] [2"x 4 1/2"] [2" x 6 1/2"]
   2. Header Sizes: [1 3/4" x 4 1/2"] [2" x 4 1/2"] or [4" x 4 1/2"]

B. Clips and Reinforcements: Manufacturer's standard high strength aluminum: ASTM B 221 and/or ASTM B 308.

C. Fasteners and Accessories: Manufacturer's standard non-bleeding and non-corrosive material congruent to adjacent material.
   1. Exposed Fasteners: To be stainless steel Philips flathead screws with appropriate finish: ASME B 18.6.4
   2. Concealed Fasteners: To be manufacturer's standard.

D. Assembly:
   1. Framing members are separate aluminum pieces cut to length and mechanically fastened from either spline or clip systems.
   2. Joinery to be hairline.
   3. Sommer and Maca Dymonic or Dow Corning® 795 Sealants applied on applicable areas.
   4. Framing elevations to be identified according to final approved drawings.

E. Anchoring:
   1. Appropriate anchoring fasteners to be secured no more than 18" apart on entire frame opening.
   2. Frame headers to receive no less than 2 anchoring fasteners.
   3. Add extra fasteners where hardware and hinge may require more.

F. Doorstop:
   1. To be #CDM-32.
      a. Wall Thickness: To be 3/16" thick for receiving applicable hardware.
      b. Profile Height: To be no less than 5/8" high.
   2. Snap-in: Fits standard manufacturer's door jamb profiles.
   3. To receive weather strip around acting door leafs.
      a. Wool pile: Solid Propylene Base with resilient fibers in a standard black color.

G. Hardware Preparation:
   1. Intramural Work: Hardware preparation according to hardware suppliers' templates.
   2. Field Work: Refer to manufacturers' installation instructions.

2.08 LOUVERS

A. Style: Extruded Aluminum, mitered corners secured with reinforcing clips, inverted-Y design.

B. Dimension: To match existing.

C. Finish: Clear

D. Installation: Louvers to be factory installed and removable from interior only.

2.09 FINISHES

A. Standard Anodic Finishes:
1. Clear 204 R1: Architectural Class 11, AA-M12C22A31, 0.4 mils.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting proper installation.

3.02 INSTALLATION

A. Comply with manufacturer's instructions.

B. Do not install damaged components.

C. Install doors plumb, level, and square, with no warp or rack in frame.

D. Hang doors with the following required clearances:
1. Lock Stiles: 0.125"
2. Between Meeting Stiles: 0.187"- 0.250"
3. At Top Rails: 0.125"
4. Between Bottom Rail and Threshold: 0.125" - 0.187"

E. Fit joints to produce hairline joints free of burrs and distortion.

F. Rigidly secure non movement joints.

G. Install recommended anchors with separators to prevent metal corrosion and electrolytic deterioration.

H. Seal joints watertight, unless otherwise indicated.

I. Place thresholds in proper weather sealant.

3.03 ADJUSTING

A. Fine-tune doors and hinges to operate properly without bind or sag.

B. Adjust pressure settings on closers.
1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

3.04 CLEANING

A. Immediately clean doors after installation.

B. Avoid any harsh cleaners not specified on manufacturer's cleaning and care guide.

3.05 PROTECTION

A. Follow Manufacturer's guide to cleaning and care for proper treatment on entrances for optimum longevity, function, and performance.

END OF SECTION

SECTION 08 51 13 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes aluminum windows for the concession building exterior locations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: For aluminum windows.

1. Include plans, elevations, sections, hardware, accessories, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:
a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
1. Minimum Performance Class: AW.
2. Minimum Performance Grade: 70.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

F. Thermal Movements: Provide aluminum windows, including anchorage, that 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 calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

G. Sound Transmission Class (STC): Rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.

2.3 ALUMINUM WINDOWS

A. Manufacturers: Subject to compliance with requirements,
1. YKK AP America Inc. BOD, YFW 400 TU fixed window.
2. EFCO Corporation.
3. Kawneer North America, an Arconic company.

B. Types: Provide the following types in locations indicated on Drawings:
1. Fixed.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.
   a. Frosted and fully tempered.
2. Low-E Coating:

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials.

2.4 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

D. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

E. Window Assemblies: Provide fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:

1. Angled mullion posts with interior and exterior trim.
2. Angled interior and exterior extension and trim.
3. Exterior head and sill casings and trim.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.5 GENERAL FINISH REQUIREMENTS

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

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: non specular as fabricated; 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.

1. Color: silver anodized.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 51 13

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes commercial door hardware for the following:
   1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical door hardware.
   3. Cylinders specified for doors in other sections.

C. 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 70 - National Electrical Code.
   4. NFPA 101 - Life Safety Code.
   5. State Building Codes, Local Amendments.

D. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
   1. ANSI/BHMA Certified Product Standards - A156 Series.
   2. UL10C - Positive Pressure Fire Tests of Door Assemblies.

1.2 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.
h. Warranty information for each product.

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. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.
2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. 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 Procedures.

1.3 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. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door 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.

D. 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 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.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source 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.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing 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 according to manufacturer's instructions and recommendations and according to approved schedule.

1.4 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".

1.5 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: 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.

1.6 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. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

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.

B. 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:
1. 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.

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
1. Permanent cylinders, cores, and keys to be installed by Owner.

D. 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 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
   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 Options: Comply with the following:
   a. Non-removable Pins: With the exception of electric through wire hinges, 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 all out-swinging lockable doors.

4. Manufacturers:
    a. McKinney (MK) - TA/T4A Series, 5 knuckle.

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
    1. Manufacturers:
        a. Securitron (SU) - EL-CEPT Series.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
    1. Provide one each of the following tools as part of the base bid contract:
        a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
        b. McKinney (MK) - Connector Hand Tool: QC-R003.
    2. Manufacturers:
        a. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
    1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
    2. Furnish dust proof strikes for bottom bolts.
    3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
    4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
    5. Manufacturers:
        a. Rockwood (RO).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified 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 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. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
6. Manufacturers:
   a. Rockwood (RO).

2.5 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.
   1. Manufacturers:

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
   1. Threaded mortise cylinders with rings and cams to suit hardware application.
   2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
   4. Tubular deadlocks and other auxiliary locks.
   5. 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.

C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Keying System: Each type of lock and cylinders to be factory keyed.
   1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:
   1. Construction Keys (where required): Ten (10).
   2. Construction Control Keys (where required): Two (2).

F. Construction Keying: Provide temporary keyed construction cores.

G. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all features and functionality as specified herein.
   1. Manufacturers:
      a. Sargent Manufacturing (SA) - 8200 Series.

2.7 AUXILIARY LOCKS

A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
   1. Manufacturers:
      a. Sargent Manufacturing (SA) - 4870 Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   1. Strikes for Mortise Locks and Latches: BHMA A156.13.
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

2.9 ELECTRIC STRIKES

A. Standard Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability with field selectable fail-secure/fail-safe. Where specified provide latchbolt monitoring indicating both the position of the latchbolt and locked condition of the strike.
   1. Manufacturers:
      a. Adams Rite (AD) - 7100 Series.

2.10 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.
   2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
   3. 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 Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
   4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
   5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
   6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed 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 or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
   1. Heavy duty surface mounted door closers shall have a 30-year warranty.
   2. Manufacturers:
      a. Sargent Manufacturing (SA) - 351 Series.

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency 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 of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.
   1. Manufacturers:
      a. Sargent Manufacturing (SA) - 422 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim
   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
   a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
   a. Rockwood (RO).

2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
   1. Manufacturers:
      a. Rockwood (RO).

2.13 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 and provide smoke, light, or sound gasketing on interior doors where indicated. 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. Manufacturers:
   1. Pemko (PE).

2.14 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.

2.15 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. DHI TDH-007-20: Installation Guide for Doors and Hardware.
   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 (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
   1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

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. 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 SETS

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.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. SA - SARGENT
6. AD - Adams Rite
7. OT - Other

Hardware Sets

Set: 1.0

Doors: G104 (custodial)

1	Continuous Hinge	CFM__SL_-HD1 - DOOR HEIGHT		PE
1	Storeroom Lock	72 8204 LNNJ	US32D	SA
1	Keyed Core (SFIC)	BY OWNER		
1	Blade Stop Spacer	581-2	EN	SA
1	Mounting Plate (PA)	351A	EN	SA
1	Surface Closer	351 CPSH	EN	SA
1	Perimeter/Mtg Stile Seal	BY FRAME / DOOR SUPPLIER		OT
1	Sweep (w/drip edge)	3452CNB		PE
1	Threshold	271A MSES25SS		PE
1	Door Position Switch	BY SECURITY		OT
1	Viewer	622	CRM	RO

Set: 2.0

Doors: G102 (Family Restroom)

1	Continuous Hinge	CFM__SL_-HD1 - DOOR HEIGHT		PE
1	Keyed Privacy Lock	V21 72 8225 VN1NJ	US32D	SA
1	Surface Closer	422 CTB2	EN	SA
1	Door Stop (HD floor)	471	US26D	RO
1	Perimeter/Mtg Stile Seal	BY FRAME / DOOR SUPPLIER		OT

1	Sweep	315CN		PE
1	Threshold (1/2" high)	169A MSES10SS		PE
1	Door Position Switch	BY SECURITY		OT

Set: 3.0

Doors: G101, G103 (men and women restrooms)

1	Continuous Hinge	CFM__SL_-HD1 - DOOR HEIGHT		PE
1	Public Toilet Deadlock	72 4878	US32D	SA
2	Keyed Core (SFIC)	BY OWNER		
1	Flush Pull	94DLS	US32D	RO
1	Door Pull	BF Y 110-RKW Mtg-Type 1	US32D	RO
1	Push Plate	70F (8 x 16)	US32D	RO
1	Surface Closer	422 CTB2	EN	SA
1	Door Stop (HD floor)	471	US26D	RO
1	Perimeter/Mtg Stile Seal	BY FRAME / DOOR SUPPLIER		OT
1	Sweep	315CN		PE
1	Threshold (1/2" high)	169A MSES10SS		PE
1	Door Position Switch	BY SECURITY		OT

Notes:
• Mount 94DLS flush pull on the push/exterior side of door.

Set: 4.0

Door: 102 to press box

1	Electric Strike (fail secure)	7160 510	628	AD
1	Card Reader	BY SECURITY		OT
1	Door Position Switch	BY SECURITY		OT
1	Lock / Strike Power	BY SECURITY		OT

Notes:
• Balance of hardware by door supplier.
• Coordinate electric strike requirements with Press Box door supplier.
• Electronic Operation: Valid card releases electric strike; key retracts latchbolt. Free egress at all times. In case of power loss or fire alarm (if rated), door remains locked and latched.

Set: 5.0

Doors: 101 to press box

1	Keyed Core (SFIC)	BY OWNER	
1	Door Position Switch	BY SECURITY	OT

END OF SECTION 087100

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior gypsum board for soffits and fascia.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type and color of the following:

1. Trim Accessories: Full-size sample in 12 inch long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install panels that are wet, moisture damaged, and mold damaged:

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Protect sills, ledges, and projections from mortar droppings.
3. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS.

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Manufactures: subject to compliance with requirements, provide products by one of the following:
   a. Certain Teed Corporation
   b. Continental Building Products, LLC
   c. Georgia-Pacific Building Products
   d. National Gypsum Company
   e. USG Corporation
2. Core: 5/8 inch. Type X

2.2 TRIM ACCESSORIES

A. Exterior Trim: ASTM C 1047
   1. Material: Hot dip galvanized-steel sheet, plastic or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped, exposed long flange receives joint compound.
      c. Expansion (control) joint: one piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.3 JOINT TREATMENT MATERIALS

A. Joint tape:
   1. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

B. Joint compound for exterior applications.
   1. Glass-mat Gypsum sheathing board: as recommended by sheathing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation and reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 INSTALLATION, GENERAL

A. Apply panels perpendicular to supports, with end joints staggered and located over supports
   1. Install with 1/4-inch (6..4-mm) open space where panels abut other construction or structural penetrations
   2. Fasten with corrosion-resistant screws.

3.3 INSTALLING TRIM ACCESSORIES

A. General: trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Exterior trim: install in the following locations.
   1. Cornerbead: Use at outside corners
   2. LC-bead: Use at exposed panel edges.

3.4 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surfaces.

C. Glass mat Faced Panels: Finish according to manufacturer's written instructions.

3.5 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Remove and replace panels are wet, moisture damaged or mold damaged.

END OF SECTION 09 29 00

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 250 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL BASE

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. Armstrong World Industries, Inc.
2. Johnsonite; A Tarkett Company.
3. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).

1. Group: II (Layered).
2. Style and Location:
   a. Style B, Cove.

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors and Patterns: SEE DRAWINGS

2.2 INSTALLATION MATERIALS

A. Trowel able Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowel able leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 – GENERAL

PART 1 - 1.01 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 surface preparation and the application of paint systems on interior substrates including but not limited to the following:

1. Concrete floor (**Armor AX25 Siloxane Infused High Gloss Acrylic Sealer) attached.**
2. Concrete masonry units (CMU).
3. Steel.
4. wood

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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. Duron, Inc.
2. M.A.B. Paints.
3. PPG Architectural Finishes, Inc.

1. Sherwin-Williams; Paint Stores Group.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

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.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Colors: **As selected by Architect from manufacturer's full range**

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

A. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based: MPI #107.

2.6 WATER-BASED PAINTS

A. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3): MPI #145.

B. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.

2.7 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer**.**

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

B. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in occupied spaces and/or exposed in equipment rooms.
    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At the end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System:
    a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
    b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.
    d. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 4), MPI #147.

B. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System:
    a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
    b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.
    d. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 4), MPI #147.

C. Wood substrates
1. Institutional Low-odor/VOC Latex System
    a. Prime Coat: Primer-sealer for interior wood.
    b. Intermediate Coat: Pre-catalyzed Epoxy, matching topcoat.
c. Topcoat: Pre-catalyzed Epoxy

Armor AX25 Siloxane Infused High Gloss Acrylic Sealer

Foundation Armor
3 Howe Drive, Suite 2
Amherst NH 03031
(866) 306-0246
FoundationArmor.com
For Professional Use

PRODUCT DESCRIPTION

The Armor AX25 is a solvent-based siloxane infused high gloss acrylic sealer designed to enhance, seal, and protect concrete, and concrete pavers. It will darken the surface to enhance any dull and faded coloring, protect the surface with a durable high gloss surface film. The Armor AX25 offers superior water repellency benefits making it a perfect choice for areas constantly exposed to water, such as pool decks.

BENEFITS/FEATURES

- Breathable, UV resistant
- Reduces deterioration caused by surface abrasion
- Reduces the formation of mold, mildew, and algae
- Reduces surface stains
- Offers superior water repellency benefits
- Easy to apply, maintain, and recoat
- Made from US Manufactured non-recycled resins
- Will darken the surface to make it look wet
- Can be applied to unsealed surfaces, and surfaces previously sealed with a solvent based acrylic sealer

SUGGESTED APPLICATIONS

- Poured, broom finished, and stamped concrete.
- Concrete pavers.
- Exposed aggregate concrete.
- Driveways, walkways, patios, and stairs.
- Salt water and fresh water pool decks.
- Garage, warehouse, and basement floors.
- Car ports, pole barns, retail and restaurant floors.

TECHNICAL INFORMATION

Solids	25%
Drying Time	4-6 hours
Re-Coat Time	24 hours
Foot Traffic	24 hours
Wheel Traffic	24 - 48 hours
Application Temp	55°F - 85°F
Wet Appearance	Clear
Dry Appearance	High Gloss
VOC Content	<700 VOC
Blush Resistance	Good
Solvent Resistance	Minimal
Concrete Adhesion	Excellent

COVERAGE

Porous Surfaces: Up to 175 FT2/gallon in one coat.
Smooth Surfaces (once properly prepped): Up to 200-225 FT2/gallon in one coat.

Coverage will vary depending on porosity, surface condition, application method, and the amount of material applied by the applicator. The above coverage rates are estimates and will vary. Two coats are suggested for even coverage and appearance.

COMPLIANCES

- USDA Compliant

SHELF LIFE

When properly sealed and stored, the shelf life of the Armor AX25 is up to 1 year.

PACKAGING

The Armor AX25 is available in a 16 OZ Sample, 1 Gallon Bottle, 5 Gallon Pail, and 55 Gallon Drum.

APPLICATION INSTRUCTIONS

The Armor AX25 can be applied with a 3/8-1/2" nap roller, or a solvent resistant HVLP sprayer. For a consistent wet look and high gloss finish, apply two coats spaced 24 hours apart.

Time Of Day
The Armor AX25 should only be applied in the early evening when air and surface temperatures are declining, and when the sun is no longer positioned over the surface. To avoid bubbling and hazing, do not apply in the morning or middle of the day.

Surface Preparation
The Armor AX25 should be applied to a completely clean and dry surface. If the surface was cleaned with water or pressure washed prior to application, allow the surface to dry for at least 24 hours before sealing. While pressure washing the surface is typically sufficient, spot treatment may be necessary for deep or older stains.

The Armor AX25 is designed specifically for use on unsealed concrete and concrete paver surfaces, as well as concrete and concrete pavers previously sealed with a solvent based acrylic. If the concrete is smooth or trowel finished, and doesn't quickly and easily absorb water, other surface preparation may be required to open up the surface pores, such as acid etching or grinding.

The Armor AX25 should not be used to seal clay brick, red Chicago pavers, flagstone, slate, or natural stone. If you are looking to seal clay brick, red Chicago pavers, flagstone, slate, or natural stone, consider instead of the Armor WL550 or the Armor SX5000 WB.

Note About Sealing Pavers:
Please note, while the Armor AX25 can be applied over paver joints, it is not designed as a bonding agent and will not harden or bond the loose sand in the paver joints. If applying with a roller, loose sand in the joints may cling to the roller and be redistributed across the pavers. For best results, apply first coat with a sprayer if you are applying to pavers with loose sand in the paver joints.

When applying to porous pavers, gloss level may be reduced, and more material may be required to achieve desired finish.

Mixing Opaque Color Packs: Do not exceed more than 6 ounces of color per gallon of sealer. Stir color well before adding to sealer, then once added to sealer, stir again, ensuring color is evenly mixed. Once cured, will cover like a paint—you will be left with an opaque colored finish.

Mixing Semi-Transparent Color Packs: Do not exceed more than 1 ounce of color per gallon of sealer. Stir color well before adding to sealer, then once added to sealer, stir again, ensuring color is evenly mixed. Once cured, will offer a semi-transparent tinted finish.

Adding Non-Slip: For added surface traction, the Armor Non-Slip additive can be added. The ultra-fine, fine, and coarse Armor Non-Slip additives works best in the Armor AX25. Applying the Ultra-Fine: Slowly drill mix 3-6.5 ounces of non-slip additive per gallon of sealer, until completely blended, then apply. For Fine and Coarse: When applying the second coat, add the non-slip additive to the coating using a broadcast spreader, and back roll to encapsulate the non-slip additive.

Clean-Up
Use Xylene or acetone. Dispose of containers in accordance with local and federal regulations.

Product Removal
Dried, cured sealer may be removed with a the Armor CR100, or by using a diamond grinding method, sandblasting method or similar mechanical action.

PRECAUTIONS AND LIMITATIONS

- When applying, odors are strong. Area should be properly ventilated during the time of application, and for at least 7 days after application, to allow for the solvents to fully release and the odors to dissipate.
- HVAC ducts should be blocked to avoid distribution of solvents and odors. Extinguish any pilot lights or other sources of ignition prior to starting.
- Coverage rates depend upon many conditions including application method, surface porosity, and applicator.
- Please be aware that this product when cured may be slippery when wet. We suggest a non-slip additive where slipperiness is a concern.
- Sealer is not resistant to brake fluid, gasoline, and many other similar products.
- Do not dilute or thin sealer with any products.
- White spots (blushing) and premature delamination or failure may occur if applied to wet surfaces, surfaces with moisture issues, or surfaces that get wet before the sealer has fully cured. Do not apply in early morning if morning dew is present.
- Do not apply in the morning or middle of the day to avoid hazing and bubbling.
- Store product in an area where the temperature is between 55-80 degrees F, and not in direct sunlight. Keep away from open flames, sparks, or other sources of ignition.
- If applying sealer to pavers less than one year old, verify with paver manufacturer that pavers are able to be sealed. Sealing before suggested guidelines can result in coating failure.
- Proper personal protective equipment should be worn when applying this product. Refer to the Safety Data Sheet prior to application.
- Properly protect and cover any areas not intended or suggested to be sealed during application.
- Do not apply over sealers, water based acrylics, acrylic latex, paint, or any other film-forming coating other than a solvent based acrylic. If the solvent based acrylic is deteriorating, repair or remove prior to application. Apply to a test area before sealing to verify compatibility.
- This product does not stop hot tire pickup or tire marks.
- Plasticizers in rubber mats and rubber based materials may react and bond to cured coating.
- In all cases, refer to the Safety Data Sheet prior to application for complete health and safety information. Do not swallow, avoid direct contact with skin, avoid inhalation, keep out of reach of children and pets.
- Foundation Armor offers no guarantee, warranty or other claims to the success or results of a job or project.
- The applicator is responsible for suitability of application, and the results of the application. We suggest applying to a test area first to verify compatibility, absorption, coverage rate, and project suitability. Applicator is also responsible for ensuring product meets local VOC regulations, and any and all other regulations that may apply.
- Product is not returnable once opened or used so please consider purchasing a 16 ounce sample to test product before purchasing larger quantities.

END OF SECTION 09 91 23

SECTION 10 14 00 (SECTION 10400) - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
1. HID Signage.

1.2 SUBMITTALS

A. Product data.
C. Operating And Maintenance Manuals.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturer: HOWARD INDUSTRIES Architectural Signage System. www.howardindustries.com • 6400 Howard Drive, Fairview PA 16415 • Toll Free 800.458.0591. • PA 814.833.7000
Or approved equal.

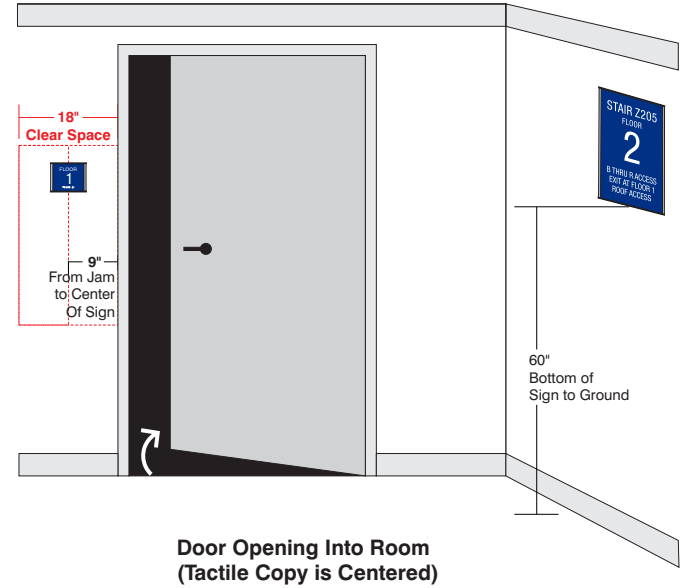
PART 3 - EXECUTION

3.1 INSTALLATION: Install in accordance with Penn State standards and accessibility standards. Found on the OPP site
https://oppwiki.atlassian.net/wiki/spaces/OPPDCS/pages/5409571/10+10+00+INFORMATION+SPECIALTIES?preview=/5409571/117637137/2023_PSU%20Interior%20Standards%20Manual.pdf

END OF SECTION

***Please use a silicone adhesive as well as the provided tape for installation on drywall or masonry block**

Door Opening Towards You
(Tactile Copy is Centered)

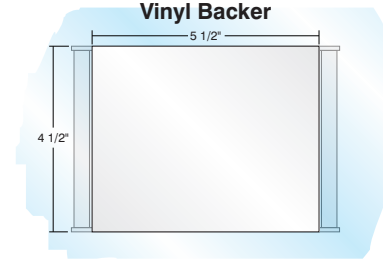


Door Opening Into Room
(Tactile Copy is Centered)

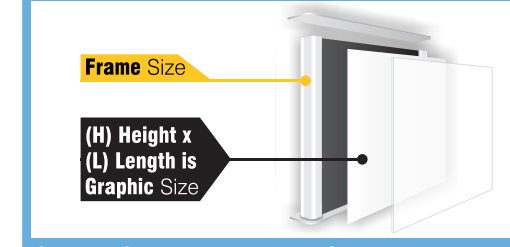
Sign 1	Sign 2
STAIR Z205 FLOOR 2 B THRU R ACCESS EXIT AT FLOOR 1 ROOF ACCESS	FLOOR 1

Sign 1	Sign 2
STAIR Z205 FLOOR 2 B THRU R ACCESS EXIT AT FLOOR 1 ROOF ACCESS	FLOOR 1

Vinyl Backer

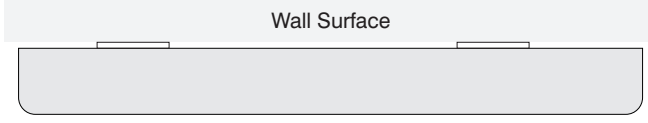


WMP-F SERIES DETAIL

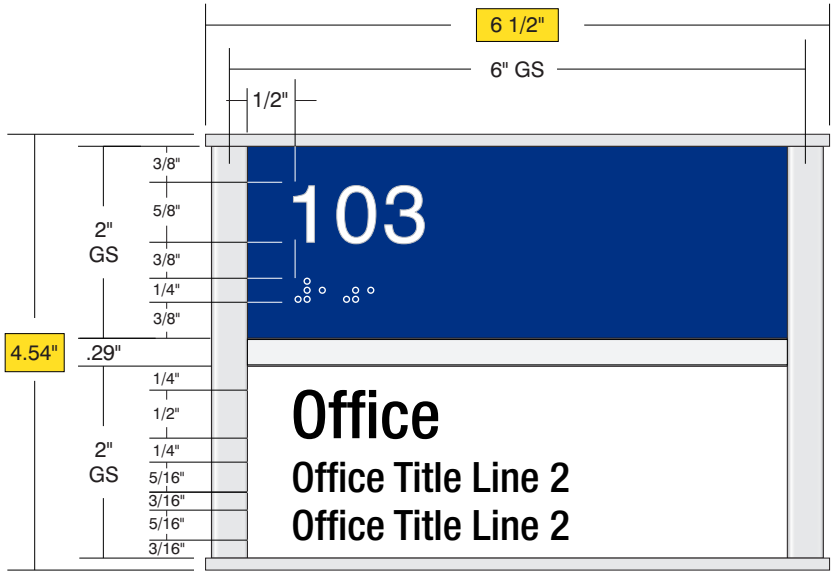


Graphic Size is also the **Lens Size-**
Extends into the frame 3/16"

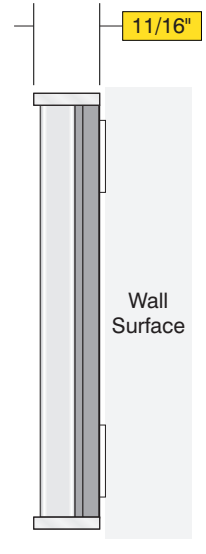
Top View



Front View



Side View



Scale: 1" = 2"

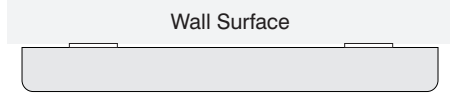
NOTE: Background graphics/color may vary as well as color of tactile

Part ID	QTY	Material/Color/Finish		H x W (in)
• Frame	2	HID Anodized Aluminum		4.29
• Backer	1	2mm Black Sintra		4.29 x 1.875
• Top/Bottom Panel	2	.044 Black SD Backer		2.1 x 6.188
• Divider	1	Extruded Rubber	Black or Silver	5.625
• Lens	2	ADA-Matte Clear	.0625	2 x 6
• Top Paper Insert	1	Printed Color (PMS# 287C)		2 x 6
• Bottom Paper Insert	1	.500 Helvetica67 Con. Med.; .3125 Helvetica67 Con. Med., White		2 x 6
• ADA Print	1	Bright White (204)	Helvetica	.625
• *w/Grade 2 Braille*				
• End Caps	2	.125 Platinum; Color: PSU Platinum	.125	6.0F (6.5)
• Mounting	4	White Adhesive Squares	.0625	.75 x .75
• Vinyl Backer	1	Control Tac - (180MC Satin Aluminum)		4.5 x 5.5

PSU Interior Signage Standards: **Restroom Identification - Sign Type HID WMP-F610**

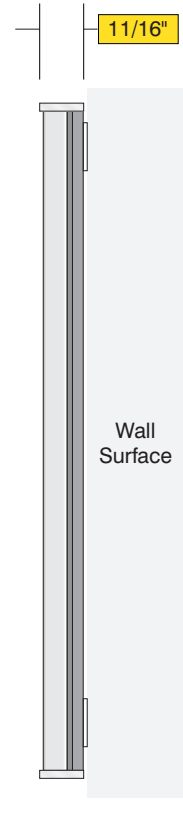
Single Face, Wall Mount

Top View



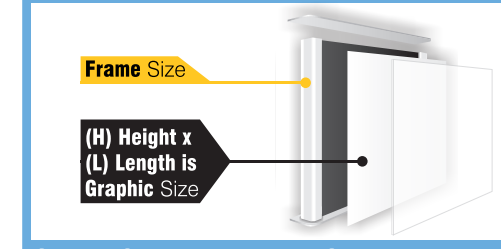
Front View

Side View



Scale: 1" = 3"

WMP-F SERIES DETAIL



Graphic Size is also the **Lens Size-**
Extends into the frame 3/16"

NOTE: Background graphics/color may vary as well as color of tactile

Part ID	QTY	Material/Color/Finish		H x W (in)
• Frame	2	HID Anodized Aluminum		10.29
• Backer	1	2mm Black Sintra		10.29 x 1.875
• Top Panel	1	.044 Black SD Backer		2.1 x 6.188
• Bottom Panel	1	.044 Black SD Backer		8.1 x 6.188
• Divider	1	Extruded Rubber	Black or Silver	5.625
• Top Lens	1	ADA-Matte Clear	.0625	2 x 6
• Bottom Lens	1	ADA-Matte Clear	.0625	8 x 6
• Top Paper Insert	1	Printed Color (PMS# 287C)		2 x 6
• Bottom Paper Insert	1	Printed Color (PMS# 287C)		8 x 6
• ADA Print	1	Bright White (204)	Helvetica	.625
• *w/Grade 2 Braille*				
• Raised Pictogram	1	Bright White (204)		3.5
• End Caps	2	.125 Platinum; Color: PSU Platinum	.125	6.0F (6.5)
• Mounting	4	White Adhesive Squares	.0625	.75 x .75

OPTION #1: Accessible Restroom (in Braille)

OPTION #1: Non-Accessible Restroom (in Braille)

SECTION 10 21 16 - SOLID PLASTIC TOILET COMPARTMENTS

PART 1GENERAL

1.1 SUMMARY

A. Section Includes:
1. Solid plastic toilet compartments, urinal screens, privacy screens, and entry partitions.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
1. B85 - Standard Specification for Aluminum-Alloy Die Castings.
2. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association (NFPA) 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.3 SYSTEM DESCRIPTION

A. Compartment Configurations:
1. Toilet partitions: Floor mounted, overhead braced.
2. Urinal screens: Wall mounted.

1.4 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings: Include dimensioned layout, elevations, trim, closures, and accessories.
2. Product Data: Manufacturer's descriptive data for panels, hardware, and accessories.
3. Samples: 2 x 3 inch samples showing available colors

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5-year experience in manufacture of solid plastic toilet compartments with products in satisfactory use under similar service conditions.

B. Installer Qualifications: Minimum 5-year experience in work of this Section.

1.6 WARRANTIES

A. Provide manufacturer’s 25 year warranty against breakage, corrosion, and delamination under normal conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Eclipse by Scranton Products. (www.scrantonproducts.com)

B. Substitutions: Under provisions of Division 01

2.2 MATERIALS

A. Doors, Panels and Pilasters:
1. High density polyethylene (HDPE), fabricated from extruded polymer resins, forming single thickness panel.
2. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments.
3. 1 inch thick with edges rounded to 1/4 inch radius.
4. Fire hazard classification: Class B flame spread/smoke developed rating, tested to ASTM E84.
5. Color: [To be selected from manufacturer's full color range

B. Aluminum Extrusions: ASTM B221, 6463-T5 alloy and temper.

C. Aluminum Die Castings: ASTM B85, A380 alloy.

D. Injection Molded Plastic: High density polyethylene.

E. Rubber: Abrasion resistant Styrene Butadiene Rubber, 65 to 80 Shore A durometer, black.

2.3 HARDWARE

A. Hinges:
1. Inswing hinges:
a. Hidden pivot type fabricated from heavy-duty cast aluminum.
b. Auto-close feature, adjustable to 15 degree open position.
c. Mounted to doors with stainless steel Torx head screws and through bolted to metal post with tamper proof Torx head sex bolts.
d. Hinge pivot point: 6 to 8 inches from edge of door; maintain sufficient clearance to water closet.
2. Outswing hinges:
a. Fabricated from extruded aluminum.
b. Auto-close feature, adjustable to 15 degree open position.
c. Surface mounted to doors with stainless steel Torx head screws and fastened to metal posts with countersunk tamper proof screws.
3. Provide for field adjustment of plus or minus 0.125 inch laterally and plus or minus 0.125 inch vertically.

B. Door Keeper:
1. 3.5 inches long, fabricated from heavy duty extruded aluminum, clear anodized finish.
2. Mount in gap between dividing panel and door.

C. Latch and Housing:
1. Heavy duty extruded aluminum.
2. Latch housing: Clear anodized finish.
3. Slide bolt and button: Black anodized finish.

D. Coat Hook/Bumper: Combination type, chrome plated Zamak.

E. Door Pulls and Push Plates:
1. Heavy duty extruded aluminum, clear anodized finish.
2. Single component providing door pull capability on outswing doors.

2.4 COMPONENTS

A. Doors and Dividing Panels:
1. 55 inches high, mounted 14 inches above finished floor.
2. Doors: 60 degree angle on two opposite edges for enhanced privacy.
3. Dividing panels: Slotted on one edge to accept wall bracket.

B. Metal Posts: 82.75 inches high, heavy duty extruded aluminum, clear anodized finish, fastened to foot with stainless steel tamper resistant screw.

C. Hidden Shoe (Foot): One-piece molded polyethylene invisible shoe inserted into metal post and secured to metal post with stainless steel tamper resistant screw.

D. Headrail Cap and Corner Cap: One-piece molded polyethylene secured to metal post with stainless steel tamper resistant screw; adjustable to level headrail to finished floor.

E. Hidden Wall Brackets: 61 inches long, heavy-duty extruded aluminum, clear anodized finish, inserted into slotted panel and fastened to panels with stainless steel tamper resistant screws.

F. Headrail: Heavy duty extruded aluminum, designer anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant screw and to headrail cap or corner cap with stainless steel tamper resistant screw.

G. Headrail Brackets: Heavy duty extruded aluminum, clear anodized finish, secured to wall with stainless steel tamper screws.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install compartments in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Install rigid, straight, plumb, and level.

C. Locate bottom edge of doors and panels above finished floor as indicated in drawings.

D. Provide uniform, maximum 3/8 inch vertical clearance at doors.

E. Not Acceptable: Evidence of cutting, drilling, or patching.

3.2 ADJUSTING

A. Adjust doors and latches to operate correctly.

END OF SECTION

SECTION 10 81 13 – BIRD CONTROL DEVICES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Bird Screen Welded Wire Mesh Barriers

B. Mounting Hardware –

A. Surface Cleaning System –

1.3 – SUBMITTALS

A. Product Literature.

1.4 – STORAGE & HANDLING

B. Keep in the original packaging or on shipping pallet until needed for installation.

PART 2 – PRODUCTS

A. MANUFACTURER. BOD: Nixalite of America E: birdcontrol@nixalite.com or planning@nixalite.com
www.nixalite.com

B. Bird screen welded wire mesh barriers

1. Galvanized ½" Bird Screen Welded Wire Mesh Barrier:
Wire: 0.041" (19 ga.) (1.04mm) diameter steel wire
Process: Welded and hot dip galvanized
Mesh size: ½" (12.7mm) square mesh

C. Wire mesh mounting hardware

Installer to contact manufacturer for up-to-date information and recommendations for hardware applications, item combinations, new items and new procedures. Use the hardware system recommended by the manufacturer.

D. Mounting Hardware:
All stainless steel mounting hardware including; mounting clips, sheet metal screws, masonry anchors, drive screws and ductile stainless wire ties.

E. E-Z Clips: All stainless steel U-shaped brackets with mounting holes. Accepts Premium Nixalite sheet metal screw and drive screw. Fits over the edges of the Bird Screen Welded Wire Mesh Barriers.

F. Additional Installation Methods: Due to the versatility and ease of installation, there are many possible methods for fastening. Contact manufacturer for details regarding details and procedures.

G. 2.4 – SURFACE CLEANING SYSTEM

1. Steri-Fab: Surface disinfectant and bactericide designed to neutralize bird waste, making it safe for removal. Steri-Fab quickly kills disease causing bacteria, parasites, fungi, insects, etc. This is a non-residual product. It becomes completely inert after it dries. Do not use with Microcide-SQ on the same surface at the same time.

2. Microcide-SQ: A broad spectrum disinfectant, cleaner and deodorizer used to sanitize hard surfaces as well as fabrics and clothing. Use to kill a wide spectrum of organisms and disease causing bacteria. Do not use with Steri-Fab on the same surface at the same time.

3. Microsan: Anti-microbial personal protection products to help prevent disease transmittal before, during and after working on and around surfaces contaminated with bird and animal wastes. Use to compliment personal protection equipment standards (PPE).

PART 3 – EXECUTION

A - PREPARATION

Field Measurements: Verify dimensions of the areas to be enclosed. Make sure you have sufficient quantity of Bird Screen Welded Wire Mesh Barrier, installation hardware and surface cleaning products to properly complete the installation.

C-SURFACE CLEANING

1 All surfaces to be clean, dry and free of obstructions before the Bird Screen Welded Wire Mesh is installed.

2 If Bird Waste Is Present:
Treat, neutralize and safely remove all bird waste from installation surfaces. Installer must follow all municipal, state and federal regulations regarding the proper removal and disposal of bird droppings and waste materials such as nests and dead birds.

C- INSTALLATION

3 1 Install the Bird Screen Welded Wire Mesh Barrier as recommended by manufacturer.

4 2 If joining separate pieces of mesh together end to end, overlap by at least 2 mesh and secure with the appropriate wire tie or fastener.

5 3 Install Bird Screen Welded Wire Mesh Barriers to avoid contact with machinery, vehicles, etc. Make necessary adjustments to keep the installation a sufficient distance from these objects or conditions.

4 Finished Welded Wire Mesh Barrier installation to be clean, straight and gap-free.

D-ADJUSTMENTS / CLEANING

1.Remove debris and waste from project site. Inspect finished installation. Make any adjustments needed to conform to specifications.

2 Note any holes, gaps or openings in the bird net installation that birds can use to bypass or get around the netting barrier. Correct these conditions immediately.

END OF SECTION

SECTION 133416 – GRANDSTANDS, BLEACHERS, AND PRESS BOX

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Provide engineering, material, freight, installation and supervision to furnish a new permanent grandstand as shown on the drawings and specified herein. Work shall include, but not limited to the following:

1 Galvanized steel understructure.
2. Fully closed interlocking aluminum deck, riser and seats.
3. Aluminum guardrail and handrail system.
4. Egress stairs and ADA compliant access ramp.
5. Press box.
6. Aluminum skirt board closure system as indicated on drawings.
7. Space below the grandstand and between bracing for portable storage containers as indicated on drawings.

1.02 RELATED DOCUMENTS

A Drawings and general provisions of the contract, including general and special conditions and division 1 requirements, apply to this section.

1.03 RELATED SECTIONS

A. Division 1 – General Requirements

B. Division 2 – Site work

C. Division 3 – Concrete

1.04 REFERENCES

A. ASTM A36 - Carbon Structural Steel.

B. ASTM A123/A123M-02 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A307/A325 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

D. ASTM A325-07a Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

1.05 DESIGN REQUIREMENTS

A. Bleachers, grandstands and press box structures shall be designed by a professional engineer licensed in the state of Pennsylvania

B. Applicable Codes
1. International Building Code, 2018 edition.
Including ICC 300-2017
2. American with Disabilities Act.
3. Aluminum Association of America.
4 AISC Manual of Steel Construction, Load and Resistance Factor

Design, Second Edition.

C. Design Loads
1. Live load: 100 psf gross horizontal projection.
2. Live load, seat planks: 120 plf.
3. Horizontal sway load: 24 plf parallel to seat planks.
4. Perpendicular sway load: 10 plf seat planks.
5. Treads: Minimum concentrated load of 300 pounds on 4 square inches
6. Guard Rail load:
   a. Vertical load: 50 plf.
   b. Horizontal load: 50 plf.
   c. Concentrated load: 200 pounds.
7. Wind load: Per local building code

D. General: The structure shall be properly braced for wind and construction loads until all structural elements are secured. The understructure shall be of a system permitting clear openings for four storage containers. Lateral and longitudinal bays shall be properly cross braced.

1.06 SUBMITTALS

A. Submittals shall comply with section 01 33 00 – Submittal Procedures: Submittal requirements

B. Product Data:
1. Manufacturers technical data and specifications.
2. Storage and handling requirements.
3. Installation instructions.
4.

C. Shop Drawings:
1. Submit electronic copies of manufacturer's shop drawings, signed and sealed by a Professional Engineer licensed in the state of Pennsylvania, showing product dimensions, framing, deck configuration, railings, stairs, ramps and any other necessary items specified within this section.
2. Submit electronic copies of submittal drawings signed and sealed by a Professional Engineer licensed in the state of Pennsylvania, for review by code official and architect/engineer.
3. Material Samples: Submit samples of each product specified, depicting the appropriate style and color. Including siding, interior finishes and vinyl coated fence.

D. Certificates:
1. Submit manufacturers and installers liability, workers compensation and auto insurance certificates.
2. *Manufacturer's certification that materials furnished comply with requirements indicated and that materials meet or exceed test requirement indicated*.

1.07 QUALITY ASSURANCE

A. Single Source Responsibility: Single manufacturer shall provide all components required to install the products specified in this section.

B. Manufacturers Qualifications: Manufacturers must have 10 years of experience in the manufacturing of bleachers and grandstands of the type specified under the same corporate name. Any company that has been reorganized due to bankruptcy must have been in business for the10 years to qualify.

C. Engineering Qualifications: The Grandstand shall be designed and approved by a Licensed Professional Engineer registered within the state of Pennsylvania. All submittal drawings shall bear their seal.

D. Product Liability: The Grandstand Manufacturer shall provide A Certificate of Product Liability Insurance in the minimum amount of $1,000,000.00 for the life of the product. This coverage shall be in lieu of and supersede all other insurance requirements referenced within the specifications.

E. Any bid from any manufacturer/installer that has a demonstrated history of shoddy work, unsafe labor practices, failure to complete projects on time, been cited for violations of any state department of labor or has been disallowed from bidding on work in any state will be rejected.

F. Installer Qualifications: Factory-trained and experienced in the proper installation of bleachers and grandstands.

G. Welders: AWS certified.

H. **AISC CERTIFICATION**: All structural steel must be fabricated in an **AISC Certified** plant that participates in the AISC Quality Certification Program for Standards for Steel Building Structures. Only manufacturers that are able to produce a certificate of compliance issued by AISC meet this standard. Manufacturers listed on the AISC website as a "member" do not meet this requirement. All steel manufactured in a non-AISC Certified plant will be rejected. Third party on-site inspections are specifically prohibited.

I. Local Representation: Manufacturer shall have a local representative with authority to provide information and answers at a pre-construction meeting.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site with manufacturer's labels clearly identifying the products and contractor or fabricator.

B. Store materials in a clean, dry area, away from exposure to the weather until they are ready for installation.

C. Protect materials while handling to avoid damage during installation.

1.09 SITE CONDITIONS

A. The general contractor shall place materials suitable for surrounding the grandstand foundations and supporting storage sheds between the columns of the grandstand. ~~*The concrete slab will be placed.as part of this project*~~. See structural drawings.

B. Owner shall clearly mark all underground utilities and notify the appropriate parties prior to work commencement.

C. Proceed with work only when current or forecasted weather allows.

1.10 WARRANTY

A. The product shall be guaranteed for a period of one year after completion against defective materials. Additionally, a one-year warranty on the workmanship of the installation is also required. Furthermore, all aluminum seats and footboard members shall be warranted for a period of *5 years* against loss of structural strength, or failure of the clear (204R1) anodized finish due specifically to: atmospheric temperature fluctuations or continued outdoor exposure to rain, snow, and ultra-violet rays. Damages resulting from abnormal use, vandalism, or incorrect installation (if installed by other than an authorized manufacture's installer) shall void this warranty. Mill finish staining and/or oxidation is specifically excluded by the warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer:
Southern Bleachers Southern Bleacher Company, Inc.
P: 610-216-0827
E: treon@southernbleacher.com
Upstate NY, NJ, PA, DE & FL
www.SouthernBleacher.com
Additional acceptable manufacturers are: Dant Clayton and E & D Specialty Seating, GT Grandstands, Inc.

C. Requests for all substitutions must be approved in a written Addendum by the architect or owner.

2.02 PERMANENT GRANDSTANDS

A. Grandstands:
1. Grandstand Size as shown on the drawings.
3. Stringers shall be wide flange and placed at a maximum 6 feet on center.
4. Decking rise: as indicated on drawings.
5. Tread depth: as indicated on drawings.
6. Structural hardware: Meeting or exceeding requirements of ASTM A307.
7. Entry stairs:
a. Stair rise: Maximum of 7 inches.
b. Stair tread: Minimum of 11 inches with a contrasting nosing strip.
c. Guard Rail: 42 inches above the leading edge of step with same construction as specified for the grandstand.
d. Handrails: Anodized handrails and handrail extensions shall be no less than 34 inches or more than 38" above the nosing of the treads or landings. Handrails shall be continuous with an unobstructed handgrip area the full length of the stairs
e Handrails shall extend 12 inches beyond the bottom riser and 12 inches beyond the top riser in the direction of travel. Handrail ends shall be returned or terminate in newel posts or safety terminals.

8. Ramps:
   a. Slope: 1:12 maximum
   b. Guard Rail: 42 inches above the leading edge of step.
   c. Handrails: Anodized handrails and handrail extensions shall be no less than 34 inches or more than 38" above the nosing of the treads or landings. Handrails shall be continuous with an obstructed handgrip area the full length of the stair. Handrails shall extend 12 inches beyond the bottom of the ramp and 12 inches beyond the top of the ramp in the direction of travel. Handrail ends shall be returned or terminate in newel posts or safety terminals.
9. Aisles
   a. Minimum Width: 54 inches for interior aisles and 36 inches for end aisles unless larger aisles are required by the applicable local code.
   b. Aisles with seating on both sides must have a 34-38 inch high handrail with intermediate rail at approximately 22 inches above the tread.
   c. Aisle tread nosing shall have a contrasting color.
   d. Intermediate aisle steps: If required by the applicable code, shall be used to provide equal rise and run throughout the aisle. Each shall have an contrasting nosing.
10. Accessible Seating:
   a. Provide wheel chair spaces as required by the ADA.
   b. Any adjacent riser area to be closed using intermediate construction.

2.03 Materials

2.03.1 Structural Steel

A. All detailing, fabrication, and erection shall be in accordance with AISC Specifications, Load & Resistance Factor Design, 2nd Edition

B. Structural steel shall be ASTM A572 multi-certified grade 50, Miscellaneous steel shall be ASTM A36.

C. All bolts 5/8" diameter and larger shall be ASTM A325. All bolts 1/2” and smaller shall be ASTM A307. Threaded rod shall be ASTM A36.

D. All welds shall conform to ANSI/AWS D1.1, latest edition. Electrodes shall be E70XX.

F. Support beams shall be wide flange shapes.

G. Stringer shall be wide flange shape.

H. Guardrail support posts shall be ASTM A36 3” x 2” x ¼” structural angle.

I. Steel Finish

Structural steel shall be coated with a minimum of 2 oz. hot dipped galvanized in accordance with ASTM 123-A with a minimum galvanized film thickness of 3.3 mils. Zinc shall be 98% purity, certified with written test results based on samples taken from the tank.

2.03.3 Guardrail **-** Vertical Picket Guardrail

A. Materials:

1. Top and bottom rail shall be 1 1/2” ASTM.A36 hot rolled steel channel.

2. 6 Gauge black vinyl coated chain link fence.

3. Vertical support posts shall be ASTM A-53 steel 2” square tube seal welded top and bottom cap

B. Fabrication:

1. Welds to be full seal welds around all joints in materials.

2. All welds shall be shop welded to top and bottom channel. No partial or tack welding.

C. Finish:

Galvanized

2.03.4 Handrail

A. Two-line center aisle handrails shall be anodized extruded aluminum pipe of 6061-T6 alloy, .145” thickness.

B. Handrails shall provide a minimum 1-1/2” clearance from the guardrail material and shall extend 12” past the last riser with a return. Newel posts will not interrupt handrails. Handrails will not project more than 4.5” into the width of a stair or ramp.

C. Two line center aisle handrails shall be anodized extruded aluminum pipe of 6061-T6 alloy, 1-5/8" O.D. Rails shall be discontinuous and spacing between rails shall be not less than 22” nor more than 36”. Rails shall not span more than 5 rows of seating. Guardrail tube shall be placed at top, bottom and all ends and returns of the chain link fabric to make a perimeter framework. Tension bars do not meet this requirement. Railings are to be 42 inches high, located at all sides and long the back when bleachers are 30 inches above grade.

2.03.5 Seating

A. Seats shall be 6063-T6 extruded aluminum with a fluted surface and a minimum of 4 vertical support ribs. The exact size of seat board is 2” x 10” x .078” wall thickened at the joints and weighing 1.9 lbs. per foot with 1” radius comfort curve front edge. Aluminum shall be cleaned, pre-treated and 204 R1 clear anodized or powder coated finish selected from manufacturers standard color chart. End caps shall be cast aluminum and mechanically attached to seat board.

2.03.6 Decking System

2.03.6.1 **No penetration fully closed interlocking deck**

A. Footboards shall be 6063-T6 extruded aluminum with a fluted surface with a minimum wall thickness of 0.078" between flutes. The minimum acceptable vertical height is 1.500". Footboards shall be mill finish. Mill finish aluminum when exposed to the atmosphere forms a transparent, protective oxide coating. Mill finish aluminum will stain and the stains can be erratic in nature and can vary in color from light bronze to black. This staining is a natural occurrence.

B. Individual planks shall be interlocking lengthwise and form a “V” shaped interlocking channel and gutter system running the length of the planks.

C. Riser boards shall be 6063-T6 aluminum and shall be cleaned, pre-treated and 204 R1 clear anodized or powder coated finish selected from manufacturers standard color chart.

D. The ends of decking system will be finished with one piece mill finish aluminum channel end cap.

E. Nose planks feature an extruded channel to receive the riser plank.

F. Nose planks shall allow for a 1” extruded channel to receive the riser plank.

G. Nose planks shall allow for a 1” extruded aluminum contrasting aisle tread nosepiece located at all vertical aisles and powder coated black.

H. Heel planks shall have a lip at the back to allow the overlapping of the riser plank.

I. No through bolting of any kind shall be permitted to secure “top side” components; no exceptions.

J. Riser: 6063 T-6 aluminum alloy, corrosion resistant, maintenance free interlocking riser. Riser shall be of sufficient height to completely close the deck and interlock with the deck extrusions directly above and below the respective rise. Riser shall have a 204 R1 clear anodized or powder coated finish selected from manufacturers standard color chart.

K. A “tongue and grove” decking configuration will not be accepted.

2.03.6.2. **Walking Surface Requirement**

A. All aluminum decking intended for use as a walking surface, including walkways, aisles, walking surfaces in seating sections, stairs, ramps, platforms, handicap areas, and landings, shall be manufactured, extruded and/or treated to increase spectator safety in wet conditions. The walking surface treatment must increase the slip resistance of mill finished aluminum to achieve a slip index (coefficient of friction) of 0.80 or higher in all directions of travel, including parallel to seating, as defined by ANSI/NFSI B101.1 1-2009 test method for measuring Wet Static Coefficient of Friction of Common Hard Surface Floor Materials. All aluminum walking surfaces shall be classified as “HIGH TRACTION” as defined by the National Floor Safety Institute and as defined by ANSI/NFSI B101.1 1-2009 test method for measuring Wet Static Coefficient of Friction of Common Hard Surface Floor Materials. Certification of this classification must be included with the submittals.

B. The walking surface may be factory shot-blasted to meet the coefficient of friction of 0.80. All Shot blasted surfaces (surface profiling) must receive an anodized coating to minimize the oxidation and mill finish staining brought about by the blasting/profiling process.

C. An independent test substantiating the minimum required 0.80 coefficient of friction must be provided.

2.04 PRESSBOX MATERIALS/FABRICATION

A. Floor Construction: Per Manufacturers Standard and per engineer of record for Press Box: Basis of Design
1. Frame:
a. *Galvanized steel floor frame sized to support structure and metal pan for support of insulation.*
2. Bottom Board:
a. .030 gauge one-piece galvanized steel bottom pan.

3. Insulation:
a. as required to satisfy 2018 IECC, C402.1.5 component performance alternative, or C402.2 Specific Building Thermal Envelope Insulation Requirements (Prescriptive)
4. Joists: (Welded Framing)
a. 60CSJ16, 6 inch x 16ga. galvanized steel joists, on 16 inch centers, longitudinal framing.
5. Decking:
a. Interlock aluminum deck.
7. Molding:
a. 4 inch Resilient vinyl base.

B. Wall Construction Per Manufacturers Standard and per engineer of record for Press Box: Basis of Design
1. Studs: ~~(~~*4"x4" x 11 gauge square tubing with maximum span of 14 ft on front wall and maximum span of 6 feet on back wall and 4 ½" x 2 ½" x 14 gauge steel Cees with maximum spacing of 5 feet for all wall with siding. Spans greater than these require engineered calculations for design.*
3. Headers: (As span and design load requires)
4. Ceiling Height:
a. as shown on drawings
5. Covering:
a. 1/2 inch vinyl-faced gypsum panels, Class A F.S.R.
6. Insulation:
a. as required to satisfy 2018 IECC, C402.1.5 component performance alternative, or C402.2 Specific Building Thermal Envelope Insulation Requirements (Prescriptive)
7. Sheathing:
a. 1/2 inch CDX Dricon fire-retardant treated plywood.
8. Siding:
a. BOD-26-gauge prefinished R-panel as manufactured by MBC or equal. Vinyl-clad siding is not acceptable.

C. Roof Construction Per Manufacturers Standard and per engineer of record for Press Box: Basis of Design

1. *4" x4" x 11 gauge square tubing and 4"x 2 ½" x 14 gauge steel Cees*.
2. Overhang:
   a. As shown on drawings.
3. Ceiling:
   b. T-grid acoustical suspended ceiling system.
4. Insulation:
   as required to satisfy 2018 IECC, C402.1.5 component performance alternative, or C402.2 Specific Building Thermal Envelope Insulation Requirements (Prescriptive
5. Roof Surface
   a. *1/8" four-way steel plate roof, continuous welded seams.* 060 polyester reinforced skid and spike resistant PVC membrane, fully adhered.

D. Windows
   1. Fixed and horizontal sliders as shown on drawings. Extruded aluminum frames, AAMA LC-25 structural rating, with 1" clear insulated tempered glass and removable insect screens.

E. Doors
   1. *Exterio*r Doors to be manufacturer's standard hollow metal insulated doors with vision lite. 18 gauge skin sheets, and 16 gauge steel door frame with threshold & weather stripping. Owner to supply key cores.

G HVAC – PTAC Unit per Manufacturers Standard. See MEP drawings for coordination.

H. Electrical
   1. Service Entrance Panel
      a. furnished and installed by Press Box MFG See E601
   2. Receptacles
      a. Furnished and installed by Press Box MFG
   3. Lighting
      a. furnished and installed by Press Box MFG
   4. Circuits
      a. furnished and installed in raceway installed in factory

E Scorer's Counter
   a. as shown on drawings

2.05 FABRICATION

A. Material/Finishes:
   1. Substructures:
      a. Structural fabrication with ASTM A36 steel.
      b. Shop connections are seal welds.
      c. After fabrication all steel is hot-dipped galvanized to ASTM A123.
   2. Seating/Planking:
      a. Seat planks, backrest, riser planks and railing are extruded aluminum alloy 6063-T6. Clear anodized 204R1, AA-M10C22A31, Class II.
      b. Tread Planks: Extruded aluminum alloy, 6063-T6 mill finish.

c. Joint Sleeve Assembly: Extruded aluminum alloy, 6063-T6 mill finish.

3. Accessories:
   a. Channel End Caps: Aluminum alloy, 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II.
   b. Aisle and Stair Nosing: Extruded aluminum alloy 6063-T6, non-skid black powder coated finish.
4. Hardware:
   a. Bolts, Nuts: Hot-dipped galvanized.
   b. Tie-Down Clip: Aluminum alloy 6061-T6.
   c. Structural Hardware: Meeting or exceeding the requirements of ASTM-A307. No connections utilizing high strength bolts are classed as slip critical.
5. Factory Connections.
   a. All connections made in shop to be welded shall conform to ANSI/AWS D1.1, latest edition.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Examine all soils and footings to ensure solid and secure footings.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

D. Prepare surfaces using the methods recommended to achieve the best result based on project conditions.

3.03 INSTALLATION

A. Installation shall be performed by manufacturers certified installation crew. Installer shall be experienced in similar installations to that indicated for this project.

B. Follow all current application requirements for installation under conditions specific to the project.

D. Where manufacturer's requirements and building codes are in direct conflict, the more restrictive method of application shall prevail.

3.04 PROTECTION AND CLEAN UP

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. Prior to final inspection, clean all surfaces in accordance with manufacturers' recommendations.

D. Remove and dispose of all construction debris.

END OF SECTION

SECTION 22 00 00 - GENERAL PROVISIONS FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

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. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. 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.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 SUBMITTALS

A. Comply with Division 01 requirements for submittals.

B. Submit shop drawings and product data for approval to Architect.

C. Action Submittals 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.

D. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include 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.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

E. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return to Contractor.

F. Informational Submittals: Architect 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.

G. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

H. Each submittal shall contain shop drawings or product data for items in only one specification section. Submittals containing information about items from multiple specification sections will be returned without review.

I. Each submittal shall contain shop drawings or product data for all items in one specification section to be provided for this Project. Incomplete submittals are unacceptable and will be returned for resubmittal without review.

J. Architect will return without review submittals received from sources other than Contractor.

K. Submittals not required by the Contract Documents will be returned by Architect without review or action.

L. Clearly identify on each submittal specified items, accessories, and options, as applicable to this project. Catalog numbers, part numbers, etc. on submittals will not be reviewed for correctness. Submittals not clearly indicating only the items to be provided for this project will not be approved.

M. Submittal review by Architect is for conformance with design concept of the Project and general compliance with information given in the construction documents. Approval, corrections and/or comments made as part of the submittal review do not relieve the Contractor of the responsibility from conformance with all requirements of the Contract Documents, applicable codes and laws. Contractor is responsible for dimensions, quantities, and performance requirements to be confirmed and correlated at the job site; for information that pertains solely to the fabrication processes or to techniques of construction; and for all coordination with the Work of all trades.

N. At the time of each submittal, Contractor shall give Architect specific written notice of such variations, if any, that the Shop Drawing or product submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and sample submitted to Architect for review and approval of each such variation.

O. Architect's review and approval of Shop Drawings or products shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called the Architect's attention to each such variation at the time of each submittal and Architect has given written notation thereof incorporated in or accompanying the Shop Drawing or product approval; nor will any approval by Architect relieve contractor from responsibility for complying with the requirements of this paragraph.

P. Shop drawing submittals shall be accompanied by a transmittal sheet with the applicable specification section number and the "name" of the item or items being submitted clearly indicated on the transmittal. All "names" on the transmittal shall match exactly the "names" listed in the specifications for the item being submitted.

Q. The name of the supplier, distributor, subcontractor, etc., who will furnish equipment and items to the Contractor shall appear on the shop drawings when submitted. Shop drawing submittals without supplier's, distributors, subcontractors, etc., name will not be reviewed and will be returned without review.

R. If Architect is required to review any shop drawing or product data submittal more than two times, a Change Order will be issued to the Contractor for a credit due on the Contract Price to recoup Architect's expenses associated with the multiple reviews.

S. Complete sets of approved shop drawings and product data, as required in Division 01, shall be delivered to Owner at completion of Work.

1.4 SUBSTITUTIONS

A. Comply with Division 01 requirements for substitutions.

B. Specifications for each piece of equipment and each item of material are written around a product of a specific base manufacturer. This base manufacturer is the basis of design, dimensions, and details. The basis of design manufacturer's name and model information are included with the product descriptionas designated next to the manufacturer's name under the heading "Acceptable Manufacturers".

C. Substitution • manufacturers are defined as any manufacturer other than the one used as the basis of design. Substitution • manufacturers will be permitted, in accordance with the bidding requirements and where indicated herein.

D. Manufacturers named in the product description, in addition to the base manufacturer, are substitution manufacturers, have been determined to be manufacturers capable of manufacturing products similar to the base manufacturer and these manufacturers are acceptable substitution manufacturers to the base manufacturer. Where additional manufacturer's names do not appear with the base manufacturer, the Architect reserves the right to disallow any substitution manufacturers. Where the base manufacturer''s name is followed by the term "no substitution", no substitution manufacturers will be considered.

E. Naming of specific manufacturers shall not be construed as eliminating products or services of other substitution manufacturers having comparable items. Where permitted by these Specifications, and where Bidder desires to use other substitution manufacturers, they may submit a request for approval to use the substitution manufacturer in accordance with bidding requirements.

F. Products described in Specifications are intended to set a quality level and ensure a workable system. Substitution of manufacturers, including those herein named, may be made only after approval of Architect. Bidder shall assume full responsibility for installation and dimensional changes required by the use of all substitution manufacturer''s products, including revisions to wiring, controls, piping, structural revisions, etc., and all room or space changes as required due to dimension differences of the substitution manufacturer product. Architect approval of substitution manufacturer''s products shall be limited to compliance with information given on the Drawings and Specifications.

G. Where the Bidding requirements call for submittal for approval of substitutions prior to bids due, all approvals given are for substitution manufacturers only, not approval of any particular product. An approved substitution manufacturer's product must comply with all requirements of the specifications and drawings for the base manufacturer's product.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all materials and equipment as new, without imperfections or blemishes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Drawings are generally indicative of work to be installed but may not indicate all bends, fittings, boxes, etc. required to meet field conditions.

B. Coordinate installation of work of this Division with Work of other Divisions. Install in most direct manner possible to avoid interference between conduits, piping, ducts, equipment, and architectural or structural features. Work installed in an arbitrary manner without regard for Work of other Divisions will not be accepted.

C. Provide scaffolding and hoist or rigging materials as required for installation of Work of this Division.

D. Where equipment is furnished as Work of other Divisions for installation or wiring under Work of this Division, obtain and coordinate with approved shop drawings and installation instructions from respective contractor prior to rough-in.

E. Plumbing scope shown in each area of work shall be completed during construction phase as indicated on architectural phasing plans and/or phasing construction sequence narrative.

F. Codes and Standards:
1. Comply with all applicable local, state, national, and international codes and ordinances.
2. Reference to codes and standards listed herein shall constitute minimum acceptable requirements. Where Drawings and Specifications requirements exceed those of codes listed, Drawings and Specifications shall take precedence for Work of this Project.
3. Where applicable, materials and equipment shall bear the label of approval of Underwriters Laboratories, Inc.

G. Coordination - New Construction:

1. Openings and recesses in new construction (including cutting, patching, and finishing) necessary for installation of Work of this Division to be provided by General Contractor. Coordinate required locations, dimensional data, and scheduling of Work with General Contractor.

H. Concrete:

1. Furnish and install concrete for Work of this Division. Concrete work shall be completed in accordance with requirements of Division 03.

I. Excavation and Backfill:

1. Perform excavation and backfill required for Work of this Division, inside and outside building. Excavation and backfill shall be in accordance with requirements set forth in Division 31.

    a. Include saw cutting, trenching, backfilling, patching of all areas disturbed by excavation.
    b. Banks and excavations shall be retained by means of shoring and braces to avoid cave-ins. Shoring shall be in accordance with state and local regulatory agencies'' requirements. Shoring shall be maintained until installation, tests and inspections are complete.
    c. Pumping equipment shall be provided and maintained to pump water from excavations.

2. Comply with Pennsylvania Underground Utility Line Protection Law requirements before commencing any excavation work.

J. Painting:

1. Equipment furnished under this Division that is pre-painted or pre-finished by manufacturer shall have all nicks, scratches, blemishes, and rust spots cleaned, primed, and refinished prior to final acceptance by Owner.
2. Painting shall be in accordance with the Division 09.
3. General Contractor will paint exposed, interior and exterior unfinished equipment, conduit, supports and miscellaneous steel installed under this Division.

3.2 HAZARDOUS MATERIALS

A. Promptly notify Owner and Architect if hazardous materials are observed in the structure or on the project site during the course of Work. Do not perform any work pertinent to the hazardous material prior to receipt of special instructions from the Owner. ""Hazardous materials are defined as asbestos, PCBs, petroleum, radioactive material, or hazardous waste substances.

3.3 CLEANING

A. Upon completion of Work, remove all dirt, foreign materials, stains, fingerprints, etc., from all parts and equipment.

B. Remove all construction debris and vacuum interior spaces of all compartmental equipment.

C. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

D. Work shall be subject to inspection by the Architect.

3.4 PROTECTION FROM DUST AND DEBRIS

A. During patching, painting, ceiling removal and replacement, working on the ceiling or on things above the ceiling, etc., maintain cloths or suitable building paper covers to protect building surfaces. Protective measures (drop cloths, protective covers, etc.) shall be placed and sealed over all furniture and equipment to keep items clean and protected against dirt, dust and debris from entering furniture and equipment that the Owner has not removed.

B. Upon completion of work each day when building is occupied, remove all temporary covers, drop cloths, and debris and vacuum clean all worked-in areas to mitigate carrying of dirty materials and tracking dirt throughout building during time construction is not occurring.

END OF SECTION 22 00 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Sleeves without waterstop.
3. Sleeves with waterstop.
4. Sleeve-seal systems.
5. Grout.
6. Silicone sealants.
7. Escutcheons.
8. Thermometers, bimetallic actuated, lead free.
9. Thermowells, lead free.
10. Pressure gauges, dial type, lead free.
11. Gauge attachments, lead free.

B. Related Requirements:

1. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

1.2 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.

a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.7 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water materials for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.

C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

2.3 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.

B. Sleeves with Waterstop:

1. Description: Manufactured galvanized-steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Sleeve-Seal Systems:

1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

    a. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
    b. Pressure Plates: Carbon steel.
    c. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 of length required to secure pressure plates to sealing elements.

D. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

E. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.

    a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2. Silicone Sealant, S, P, T, NT: Single-component, , pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.

    a. Standard: ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.

2.4 ESCUTCHEONS

A. Escutcheon Types:

1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
2. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
3. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
4. Retain one or both finish options in "Split-Plate, Stamped-Steel Type" Subparagraph below that match escutcheon types retained in Part 3. Escutcheons described in subparagraph are generally available in 5/8-inch OD, 7/8-inch OD, 1-1/4-inch OD, 1-1/2-inch (38-mmm) OD, 3/8-inch IPS, 1/2-inch IPS, 3/4-inch IPS, 1-inch IPS, 1-1/4-inch IPS, 1-1/2-inch IPS, and 2-inch IPS.
5. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

B. Floor Plates:

1. Split Floor Plates: Cast brass with concealed hinge.

2.5 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Bimetallic Actuated, Lead Free:

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

    a. Ashcroft Inc.
    b. Trerice, H. O. Co.
    c. WATTS; A Watts Water Technologies Company.

2. Source Limitations: Provide lead-free bimetallic-actuated thermometers from a single manufacturer.
3. Standard: ASME B40.200.
4. Case: Liquid-filled sealed type(s); stainless steel with 3-inch nominal diameter.
5. Dial: Nonreflective aluminum with permanent scale markings and scales in .
6. Connector Type(s): Union joint, rigid, bottom; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
7. Stem: 0.25 or 0.375 inch in diameter; lead-free brass.
8. Window: Plain glass.
9. Ring: Stainless steel.
10. Element: Bimetal coil.
11. Pointer: Dark-colored metal.
12. Accuracy: Plus or minus 1 percent of span.

B. Thermowells, Lead Free:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Lead-free copper.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
6. Internal Threads: Size and thread type as required to match thermometer mounting threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length to extend one-third of pipe diameter to match thermometer stem length.
9. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
11. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

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

    a. Ashcroft Inc.
    b. Trerice, H. O. Co.
    c. WATTS; A Watts Water Technologies Company.

2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free Bourdon tube.
6. Pressure Connection: Lead-free brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
9. Pointer: Dark-colored metal.
10. Window: Glass.
11. Ring: Metal.

12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

D. Gauge Attachments, Lead Free:

1. Snubbers: ASME B40.100, lead-free brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
2. Valves: Lead-free brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.5 INSTALLATION OF METERS AND GAUGES

A. Install thermometer with thermowell at each required thermometer location.

B. Install thermowells in vertical position in piping tees.

C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

D. Install thermowells with extension on insulated piping.

E. Fill thermowells with heat-transfer medium.

F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

I. Install remote-mounted pressure gauges on panel.

J. Install valve and snubber in piping for each pressure gauge for fluids.

K. Install test plugs in piping tees.

L. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Outlet side of hot-water-balancing valve.
5. Each main hot-water-recirculating line return pipe.

M. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.
4. Inlet and outlet of each central water filter

3.6 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.7 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.8 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.9 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

    a. Sleeves with waterstops.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

    a. Sleeves with waterstops.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

    a. Sleeves with waterstops or stack-sleeve fittings.

4. Interior Wall and Partitions:

    a. Sleeves without waterstops.

3.10 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, cast brass with polished, chrome-plated finish.

B. Escutcheons for Existing Piping to Remain:

1. Chrome-Plated Piping: Split casting, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: One piece, floor plate.
2. Existing Piping: Split floor plate.

3.11 THERMOMETER, LEAD FREE, APPLICATION

A. Thermometers are to be the following:

1. Liquid-filled bimetallic-actuated type.

B. Thermometer stems are to be of length to match thermowell insertion length.

3.12 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

A. Scale Range for Domestic Cold-Water Piping:

1. 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping:
1. 30 to 240 deg F.

C. Scale Range for Domestic Cooled-Water Piping:

1. 0 to 100 deg F.

3.13 PRESSURE-GAUGE APPLICATION

A. Pressure gauges are to be the following:

1. Liquid filled, direct mounted, metal case.

3.14 PRESSURE-GAUGE SCALE-RANGE APPLICATION

A. Scale Range for Water Service Piping:
1. 0 to 160 psi.

B. Scale Range for Domestic Water Piping:

1. 0 to 100 psi.

END OF SECTION

SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING

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. Brass ball valves.
2. Iron ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Hammond Valve.
c. KITZ Corporation.
d. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

2.3 IRON BALL VALVES

A. Iron Ball Valves, Class 125:

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

a. American Valve, Inc.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. KITZ Corporation.

2. Description:

a. Standard: MSS SP-72, NSF rated for potable water.
b. CWP Rating: 200 psig.
c. Body Design: Split body.
d. Body Material: Epoxy Coated, ASTM B 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel or Teflon Fused.
i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded solder or press connection-joint ends where option is allowed in Part 2.
2. Brass ball valves, three-piece with full port and stainless steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron ball valves, Class 150.

END OF SECTION

SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING

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. Bronze swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

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

a. Crane; Crane Energy Flow Solutions.
b. Hammond Valve.
c. KITZ Corporation.
d. Milwaukee Valve Company.
e. NIBCO INC. Basis of Design: T-413-Y-LF

2. Description:

a. Size: 2" and smaller.
b. Ratings: NSF/ANSI 372 Lead Free
c. Standard: MSS SP-80, Type 3.
d. CWP Rating: 200 psig.
e. Body Design: Horizontal flow.
f. Body Material: ASTM B 62, DZR bronze.

g. Ends: Threaded or soldered. See valve schedule articles.
h. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Check Valves: In horizontal or vertical position, between flanges.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered .
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves with bronze disc, class 125, with soldered or threaded end connections.

B. Pipe NPS 2-1/2 and Larger:

1. Iron swing check valves with metal seats, Class 125, with flanged end connections.
2. Iron swing check valves with closure control lever and weight, Class 125, with flanged end connections.
3. Iron, grooved-end swing check valves, 300 CWP.

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe-positioning systems.
8. Equipment supports.

B. Related Requirements:

1. Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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

a. B-line, an Eaton business.
b. Thomas & Betts Corporation; A Member of the ABB Group.
c. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating:Pregalvanized G90.

2.5 THERMAL HANGER-SHIELD INSERTS

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

1. Carpenter & Paterson, Inc.
2. National Pipe Hanger Corporation.
3. Pipe Shields Inc.
4. Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. Hilti, Inc.
b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
c. MKT Fastening, LLC.
d. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. B-line, an Eaton business.
b. Hilti, Inc.

c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
d. MKT Fastening, LLC.

2. Indoor Applications: Zinc-coated or stainless steel.
3. Outdoor Applications: Stainless steel.

2.7 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
5. Pipe Supports: Roller.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads.
8. Height: 12 inches above roof.

D. High-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: One adjustable-height, galvanized--steel, pipe-support slotted channel or plate.
5. Pipe Supports: Roller.
6. Hardware: steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.
8. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; molded polypropylene.
3. Vertical Members: Two or more, galvanized-steel channels.
4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
5. Pipe Supports: Roller.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.

8. Height: 36 inches above roof.

2.8 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.10 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 22 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 250 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. MetalFraming System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers equipment supports.

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/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with 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 no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use and attachments for hostile environment applications.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Warning tags.

1.2 ACTION SUBMITTALS

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

B. Valve-numbering scheme.

C. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or stainless steel**,** 0.025-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E**,** and other applicable codes and standards.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

A. Material: Vinyl.

B. Minimum Thickness: 0.005 inch.

C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

E. Maximum Temperature: 160 deg F.

F. Minimum Width: 2 inches.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 WARNING TAGS

A. Description: Preprinted or partially pre-printed accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

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 identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of plumbing equipment.

B. Utilize metal equipment labels where exposed to temperatures that exceed 150 degrees F.

C. Sign and Label Colors.

1. White letters on an ANSI Z535.1 safety-green background.

D. Locate equipment labels where accessible and visible.

E. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.

B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.

C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Pipe label shall be visible from 360 degrees.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Pipe-Label Color Schedule:

1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
3. Domestic Hot-Water Return Piping: White letters on an ANSI Z535.1 safety-green background.
4. Sanitary Waste, Vent and Storm Drainage Piping: White letters on a black background.

3.6 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where indicated on drawings, or required by the AHJ.

END OF SECTION

SECTION 22 07 19 - PLUMBING PIPING INSULATION

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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 22 07 16 "Plumbing Equipment Insulation" for equipment insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 QUALITY ASSURANCE

A. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

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

a. Aeroflex USA, Inc.
b. Armacell LLC. (Basis of Design, Armaflex)
c. K-Flex USA.

2. Maximum operating temperature: 220 deg F.
3. Maximum Thermal Conductivity at 75 deg-F: 0.28 Btu x in./hr x sq. in.

G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

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

a. Johns Manville; a Berkshire Hathaway company. (Micro-Lok HP Ultra)
b. Knauf Insulation. (Basis of Design, Earthwool 1000°)
c. Owens Corning. (SSL II w/ASJ Max Fiberglass)

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ+ (or ASJ)-SSL.
3. Maximum operating temperature: 850 deg F.
4. Maximum Thermal Conductivity at 100 deg-F: 0.25 Btu x in./hr x sq. in.
5. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
6. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
2. Wet Flash Point: Below 0 deg F.
3. Service Temperature Range: 40 to 200 deg F.
4. Color: Black.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
4. Color: White.

2.4 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 58 to plus 176 deg F.
3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ+, or ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ+ or ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. Armatuff integral insulation and jacketing system.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

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

a. McGuire Manufacturing.
b. Truebro.
c. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

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

a. Truebro.
b. Zurn Industries, LLC.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Insulation installed in return air plenums must have a flame spread index of 25 and a smoke developed index of 50.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Insulation on all cold surfaces shall provide a continuous unbroken vapor seal.

H. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

I. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

K. Install insulation with least number of joints practical.

L. Insulation installed on plastic piping shall be installed with provisions for pipe expansion, without effect on insulation.

M. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

N. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

O. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

P. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

Q. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

R. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

S. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, 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 that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
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 and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.9 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water, 40-60°F:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water 140°F and Lower:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following when not located in conditioned space partitions. Where located in conditioned space partitions, the thickness may be reduced to 1-inch:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following, based on fixture specification or drawing note:

a. Protective Shielding Pipe Covers.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 20 mils thick.

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING

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. Copper tube and fittings.
2. PEX tube and fittings.
3. Piping joining materials.
4. Transition fittings.
5. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: Dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube:ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type Kwater tube, annealed temper.

C. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.

D. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

G. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PEX TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Uponor.

B. Tube Material: PEX plastic according to ASTM F 876 and ASTM F 877.

C. Fittings: ASTM F 1807, metal insert and copper crimp rings.

D. Fittings: ASSE 1061, push-fit fittings.

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

a. SharkBite, A Division of Reliance Worldwide Corporation.
b. Zurn Industries, LLC.

E. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 876; with plastic or corrosion-resistant-metal valve for each outlet.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Flanges:

1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 150 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric-Flange Insulating Kits:

1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

D. Dielectric Nipples:

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

   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products.
   c. Matco-Norca.
   d. Precision Plumbing Products.
   e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.

6. Lining: Inert and noncorrosive, propylene.
7. Victualic dielectric waterway is acceptable in lieu of lined item above.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. All pipe and fittings shall be carefully inspected for defects in workmanship prior to installation. Any item found unsuitable, cracked, or otherwise defective shall be rejected and removed from the jobsite. All pipe and fittings shall have factory applied markings, stampings, or nameplates with sufficient data for identification to determine their conformance with specified requirements.

C. During construction all openings in piping shall be kept closed except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges, or other items specifically intended for this purpose. Exercise necessary care to prevent foreign objects from entering piping material.

D. Run pipe lines straight and true, parallel to building lines with a minimum use of offsets and couplings. Use full and double lengths of pipe wherever possible.

E. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

F. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 00 "Common Work Results for Plumbing" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

G. Install shutoff valve immediately upstream of each dielectric fitting.

H. Install domestic water piping level without pitch and plumb.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install PEX tubing with loop at each change of direction of more than 90 degrees.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."

S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 00 "Common Work Results for Plumbing."

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 00 "Common Work Results for Plumbing."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 00 "Common Work Results for Plumbing."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 00 "Common Work Results for Plumbing."

W. Where plastic piping is used, it shall be the Contractor's responsibility to ensure compatibility of the installed piping system with the building¢s HVAC system. Where plenum rated materials are required by any federal, state, or municipal authority¢s construction codes, plastic piping shall be covered in its entirety by an approved fire retardant insulating material. Fire retardant insulating systems shall be certified to meet ASTM E-84 and UL 723 standards for flame spread and smoke generation. Fire retardant insulating systems shall be approved by the Authority Having Jurisdiction prior to installation.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
3. Protect valve bodies from wrench marks during work.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for PEX Tubing: Join according to ASTM F 1807 for metal insert and copper crimp ring fittings and ASTM F 1960 for cold expansion fittings and reinforcing rings.

H. Clamped Joints: Place clamps on polyethylene pipe and push pipe onto serrated portion of fitting. Use no dope or lubricant on the fitting. Pipe ends may be warmed in hot water or a mild soap solution may be used to assist pipe end and fitting insertion. Place clamp in position between threaded fitting or stop and the serration of fitting and tighten.

I. Joints for PEX Tubing: Join according to ASSE 1061 for push-fit fittings.

J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric unions are prohibited.

C. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

D. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install PEX tubing with loop at each change of direction of more than 90 degrees where indicated and provided drop ear at fixture connections.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling.

E. Unless otherwise indicated, install all piping to pumps and other equipment at line size with reduction in size being made only at inlet to pump or equipment connection.

F. Unless otherwise indicated, branch take offs shall be from top of mains or headers at either a 45 degree or 90 degree angle from the horizontal plane for air and gas lines, and from top, bottom or side for liquids.

G. Pipe joints connecting dissimilar metals shall be insulating, dielectric connections. Copper tubing shall be protected from electrolysis at contact points with ferrous metals, including temporary methods of support, by use of insulating, non conductive spacers such as rubber, fiberglass or an approved equal. Pipe hangers for bare copper tubing shall be copper plated.

H. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Before being placed into service, all new water lines, except those used exclusively as fire lines, shall be disinfected in accordance with AWWA standards. Final connections to existing water lines shall not be made until this procedure is completed satisfactorily.

B. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

D. Aboveground domestic water piping, NPS 2-1/2 and smaller, shall be one of the following (downstream of backflow preventer and PEX manifold box):

1. PEX tube, NPS 1 and smaller.

a. Fittings for PEX tube:

1) ASTM F 1807, metal insert and copper crimp rings.
2) ASTM F 1960, cold expansion fittings and reinforcing rings.
3) ASSE 1061, push-fit fittings.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following (upstream of PEX manifold box):

1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2and smaller. Use ball with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

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. Vacuum breakers.
2. Temperature-actuated, water mixing valves.
3. Strainers for domestic water piping.
4. Hose bibbs.
5. Water-hammer arresters.

B. Related Requirements:

1. Section 22 05 00 "Common Work Results for Plumbing" for thermometers, pressure gauges, and flow meters in domestic water piping.

1.3 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

C. FKM: A family of fluroelastomer materials defined by ASTM D1418.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Water Heater Anti-Siphon Vacuum Breakers:

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

   a. Ames Fire & Waterworks; A WATTS Brand
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. Watts. (Basis of Design, LFN36-M1)
   d. Zurn Industries, LLC.

2. Standard: ASSE Z21.22.
3. Application: Low -ressure steam or water service.
4. Operation: The vacuum relief valve shall have an all brass body and include a protective cap for automatic venting of a closed system to atmosphere when a vacuum is created
5. Material: Lead free-brass body.

2.4 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices TMV-2:

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

   a. Acorn Engineering Company; a Division of Morris Group International.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. Chicago Faucet. (Basis of Design, 131-CFMAB)
   d. Leonard Valve Company.
   e. POWERS; A WATTS Brand.
   f. Symmons Industries, Inc.
   g. WATTS.

2. Standard: ASSE 1070.

3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded, union or compression inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: Refer to drawings.
9. Tempered-Water Design Flow Rate: Refer to drawings
10. Valve Finish: .

B. Primary (Master Mixer), Electronic, Water Mixing Valve Assemblies TMV-1:

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

    a. Acorn Engineering Company; a Division of Morris Group International.
    b. Leonard Valve Company.
    c. POWERS; A WATTS Brand. (Basis of Design, Intellistation JR)

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed, electronically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or solder joint inlets and outlet.
7. Accessories: Manual temperature override control, check stops on hot- and cold-water supplies, and automatic hot- and cold-water shutoff upon inlet supply failure.
8. Valve Finish: Bronze.
9. Digital temperature control and monitoring module.

    a. Controls temperature within plus or minus 2 deg F.
    b. User programmable at module or through BAS.
    c. ASHRAE 188 compliance.
    d. Local and remote monitoring.
    e. BACNet protocol language(s).
    f. 115 V ac, 60 Hz.
    g. Battery backup.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.125 inch.
    c. Strainers NPS 5 and Larger: 0.25 inch.

6. Drain: Pipe plug or Factory-installed, hose-end drain valve.

2.6 HOSE BIBBS

A. Hose Bibbs, Service Area, HB- 1:

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

a. Chicago Faucet (Basis of Design, 293-E27CP)
b. T&S Brass

2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Chrome or nickel plated.
10. Operation for Finished Rooms: 1/4 turn ADA compliant lever.
11. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.7 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters WHA-1:

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

a. AMTROL, Inc.
b. Jay R. Smith Mfg Co. (Basis of Design, Hydrotrol).
c. Josam Company.
d. MIFAB, Inc.
e. Sioux Chief.
f. WATTS.
g. Zurn Industries, LLC.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Material: Copper or Stainless steel.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

B. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

C. Y-Pattern Strainers: For water, install on supply side of each .

D. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Temperature-actuated, water mixing valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

B. Adjust each pressure vacuum breaker in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections.

1. Test each pressure vacuum breaker according to authorities having jurisdiction and the device's reference standard.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 22 11 23.21 - INLINE, DOMESTIC-WATER PUMPS

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. In-line, sealless centrifugal pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. UL Compliance: UL 778 for motor-operated water pumps.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, close-coupled, sealless, overhung-impeller centrifugal pumps.

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

1. Bell and Gossett, (Basis of Design, PL Series)
2. Grundfos Pumps Corp. (UP Series)
3. TACO Comfort Solutions, Inc.
4. WILO USA LLC - WILO Canada Inc.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed or open drip-proof, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Minimum Working Pressure: 150 psig.
3. Maximum Continuous Operating Temperature: 225 deg F>.
4. Casing: Bronze, with threaded or companion-flange connections.
5. Impeller: Plastic or composite.
6. Motor: Single speed.
7. Shaft: Stainless Steel.
8. Bearings: Permanently lubricated.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 50 to 200 deg F.
3. Enclosure: NEMA 250, Type 4X.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V ac.
7. Settings: Start pump at 120 deg F and stop pump at 130 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Pump Mounting:

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

E. Install thermostats in hot-water return piping.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:

1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
2. Section 22 05 23.14 "Check Valves for Plumbing Piping."
3. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 22 05 00 "Meters and Gages for Plumbing Piping."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats, for automatic starting and stopping operation of pumps.

5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication where not permanently lubricated.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

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. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Specialty pipe fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

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

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings: ASTM A 74, Service class(es).

C. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

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

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings: ASTM A 888 and CISPI 301.

C. CISPI, Hubless-Piping Couplings:

1. Standards: ASTM C 1277 and CISPI 310.
2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Standard: ASTM C 1277.
2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Shielded, Nonpressure Transition Couplings:

a. Standard: ASTM C 1460.
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Contractor shall carefully follow the Drawings in laying out and installing his work and he shall not deviate therefrom, except for structural or interior finish interferences, and then only upon Engineer's approval.

C. All pipe and fittings shall be carefully inspected for defects in workmanship prior to installation. Any item found unsuitable, cracked, or otherwise defective shall be rejected and removed from the jobsite. All pipe and fittings shall have factory applied markings, stampings, or nameplates with sufficient data for identification to determine their conformance with specified requirements.

D. During construction all openings in piping shall be kept closed except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges, or other items specifically intended for this purpose. Exercise all necessary care to prevent foreign objects from entering material.

E. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. All pipe shall be cut to exact measurement, and installed without springing or forcing. Particular care shall be taken to avoid creating, even temporarily, undue loads, forces or strains on valves, equipment or building elements with piping connections or piping supports.

H. Unless otherwise indicated, branch take offs shall be from top of mains or headers at either a 45 degree or 90 degree angle from the horizontal plane for air and gas lines, and from top, bottom or side for liquids.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

J. Install piping to permit valve servicing.

K. Install piping at indicated slopes.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install piping to allow application of insulation.

O. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

P. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

Q. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

R. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

S. Install engineered soil and waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

T. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

    a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

2. Install drains in sanitary waste gravity-flow piping.

    a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

V. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 22 05 00 "Common Work Results for Plumbing."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 22 05 00 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
b. NPS 2 and Larger: Pressure transition couplings.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. |Install carbon steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast iron and steel soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting, valve and coupling.

E. Support vertical runs of cast iron and steel soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

F. Vent Flashing: For membrane roofing systems, vent flashing shall be provided by roof system installer. For all other systems flashing is by General Contractor.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

END OF SECTION

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

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. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts :

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

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.

d. Tyler Pipe; a subsidiary of McWane Inc.
e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch, or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Raised-head plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts - Finished Surface:

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

a. Jay R. Smith Mfg. Co. (Basis of Design, Model 4020 series)
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable Housing
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not Required.
7. Outlet Connection: Spigot.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, scoriated.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Medium Duty.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts WCO:

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

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. WATTS.
d. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:

a. Countersunk head.
b. Drilled and threaded for cover attachment screw.
c. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Trap Guard Device

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

a. Jay R. Smith (Basis of Design, Quad Close)
b. Proset (Trapguard)
c. Sure Seal Trap Sealer

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.
5. Locate at additional locations required by local ordinances.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Assemble open drain fittings and install with top of hub 1 inch above floor.

E. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

F. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

G. Install wood-blocking reinforcement for wall-mounting-type specialties.

H. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 13 19.13 - SANITARY DRAINS

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. Floor drains.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 DRAIN TRAPS

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

1. Jay R. Smith Mfg. Co. (Basis of Design)
2. Josam Company.
3. Wade; a subsidiary of McWane Inc.
4. WATTS.
5. Zurn Industries, LLC
6. Mifab.

B. Standard: CISPI 301, ASTM A888

C. Pattern: deep seal trap

1. Hub inlet and spigot outlet
2. Provide inset gaskets for hubs where required

D. Body Material: corrosion resistant cast iron.

E. Where drains and fixtures are specified without an integral trap, furnish and install deep seal P trap.

2.3 TRAP GUARD DEVICE

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

a. Jay R. Smith Mfg. Co. (Basis of Design)
b. Josam Company.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.
e. Zurn Industries, LLC
f. Mifab.
g. Provent Systems

B. Standard: ASSE 1072, ASME A112.6.3

C. Pattern: In line trap seal

D. Material: Chemically resistant elastomer.

2.4 FLOOR DRAINS

A. Cast-Iron Floor Drains FD-1:

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

a. Jay R. Smith Mfg. Co. (Basis of Design, Figure 2010)
b. Josam Company.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.
e. Zurn Industries, LLC
f. Mifab.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Seepage Flange: Required.
6. Clamping Device: Not required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Not Required.
9. Sediment Bucket: Not Required.
10. Top or Strainer Material: Nickel bronze.
11. Top of Body and Strainer Finish: Nicke Bronze.
12. Top Shape: Square.
13. Dimensions of Top or Strainer: 5 inches.
14. Top Loading Classification: Light Duty.
15. Funnel: Not required.
16. Inlet Fitting: Not required.
17. Trap Material: Cast iron.
18. Trap Pattern: Standard P-trap.
19. Trap Features: Integral trap guard device.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each fixture shall be vented and trapped. Each vent shall be extended through roof, or shall be loop vented into a common main, acceptable by code. Where a vertical vent riser connects to another vent riser, an inverted wye fitting shall be provided.

B. Provide Trap Guard Device(s) for the outlet of all drains in this section including, but not limited to, floor drains, floor sinks, trench drains, channel drains, open trap hub drains).

C. Install floor drains at low points of surface areas to be drained. Set grates of floor drains and floor sinks flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

    a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

D. Install open drain fittings with top of hub 2 inches above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 22 13 23 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

E. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

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. Commercial, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

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

    a. A. O. Smith Corporation. (Basis of Design, Series)
    b. Bradford White Corporation.
    c. PVI; A WATTS Brand.
    d. State Industries.

2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 1453.
4. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.

    a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

        1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
        2) NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.

    b. Pressure Rating: 150 psig.
    c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.

5. Factory-Installed, Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Drain Valve: Corrosion-resistant metal with hose-end connection.
    c. Insulation: Comply with ASHRAE/IES 90.1.
    d. Jacket: Steel with enameled finish or high-impact composite material.
    e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
    f. Temperature Control: Adjustable thermostat.
    g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
    h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

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

    a. A. O. Smith Corporation.
    b. AMTROL, Inc.
    c. State Industries.
    d. TACO Comfort Solutions, Inc.

2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:

    a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

5. Capacity and Characteristics:

    a. Working-Pressure Rating: 150 psig.
    b. Capacity Acceptable: 2 gal. minimum.
    c. Air Precharge Pressure: Measured domestic water system static pressure..

B. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

C. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

C. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

D. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 00 "Common Work Results for Plumbing."

E. Fill electric, domestic-water heaters with water.

F. Charge domestic-water expansion tanks with air to required system pressure.

G. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION

SECTION 22 40 10 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work of this Section shall consist of the labor, materials and equipment required for installation of plumbing fixtures and associated fittings and trim.

1.2 SUBMITTALS

A. Submit for approval in accordance with specified submittal procedures:

1. Water Closets
2. Urinals
3. Lavatories
4. Mop Receptors
5. Drinking Fountains

B. Substitute manufacturer's fixtures shall be similar in style, dimensions and quality to the basis of design manufacturer's specified model number.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fixtures shall be of one manufacturer, insofar as possible, and of first quality. Wall hung vitreous china fixture backings shall be drilled and tapped for mounting carriers specified.

2.2 WATER CLOSETS

A. Water Closet WC-1

1. Acceptable Manufacturer: American Standard Afwall, or Kohler, Toto, Sloan, Zurn.
2. Type: Wall hung, flush valve type, 1.28 gallon per flush, vitreous china, siphon jet action, elongated bowl, 1-1/2 inch top spud.
3. Seat:

    a. Acceptable Manufacturer: Church, or Beneke, Olsonite, Bemis.
    b. Extra heavy, elongated, white, open front, check hinge.

4. Battery Powered Flush Valve:

    a. Acceptable Manufacturer: Toto TET1LB32#CP, or Sloan, Zurn.

b. ADA compliant, 1.28 gallon per flush, less handle opening, battery powered infrared sensor, diaphragm or piston valve, chrome plated cover assembly with integral window, flush delay, override button, batteries, low battery flashing LED, infrared sensor adjustment, screw driver check angle stop with vandal resistant cap, sweat solder adaptor, adjustable tailpiece, vacuum breaker flush connection, spud coupling, and flange.

5. Carrier (compact or standard, as required for the application):

a. Acceptable Manufacturer: J.R. Smith, or Watts, Wade, Zurn, Josam, Mifab.
b. Cast iron, adjustable, vandal-proof trim.

B. Water Closet WC-2

1. Acceptable Manufacturer: American Standard Afwall, or Kohler, Toto, Sloan, Zurn.
2. Type: Wall hung, ADA compliant, flush valve type, 1.28 gallon per flush, vitreous china, siphon jet action, elongated bowl, 1-1/2 inch top spud.
3. Seat:

a. Acceptable Manufacturer: Church, or Beneke, Olsonite, Bemis.
b. Extra heavy, elongated, white, open front, check hinge.

4. Battery Powered Flush Valve:

a. Acceptable Manufacturer: Toto TET1LB32#CP, or Sloan, Zurn.
b. ADA compliant, 1.28 gallon per flush, less handle opening, battery powered infrared sensor, diaphragm or piston valve, chrome plated cover assembly with integral window, flush delay, override button, batteries, low battery flashing LED, infrared sensor adjustment, screw driver check angle stop with vandal resistant cap, sweat solder adaptor, adjustable tailpiece, vacuum breaker flush connection, spud coupling, and flange.

5. Carrier (compact or standard, as required for the application):

a. Acceptable Manufacturer: J.R. Smith, or Watts, Wade, Zurn, Josam, Mifab.
b. Cast iron, adjustable, vandal-proof trim.

2.3 URINALS

A. Waterless Urinal UR-1

1. Acceptable Manufacturer: Sloan WES-1000, or Toto, Zurn.
2. Type: No-flush, no-touch, waterless, vitreous china, wall hung with sealed locking cartridge. Wall bracket and anchors included.
3. Contractor shall furnish 1 additional gallon bottle of sealant for every 3 waterless urinals. A minimum one gallon of sealant shall be supplied. If urinal uses cartridge in lieu of replaceable liquid, furnish 2 additional cartridges for every waterless urinal.

B. Waterless Urinal UR-2

1. Acceptable Manufacturer: Sloan WES-1000, or Toto, Zurn.
2. Type: No-flush, no-touch, waterless, vitreous china, wall hung with sealed locking cartridge. Wall bracket and anchors included. ADA compliant.

3. Contractor shall furnish 1 additional gallon bottle of sealant for every 3 waterless urinals. A minimum one gallon of sealant shall be supplied. If urinal uses cartridge in lieu of replaceable liquid, furnish 2 additional cartridges for every waterless urinal.

2.4 LAVATORIES

A. Lavatory L-1

1. Acceptable Manufacturer: Kohler K-2032, or American Standard.
2. Type: ADA compliant, 21 inch x 18 inch vitreous china, wall hung with anti-splash rim, drilled with centers to accommodate faucet and concealed arm carriers.
3. Battery Powered Faucet:

    a. Acceptable Manufacturer: Toto EcoPower TEL5LI15R, or Sloan.
    b. Automatic infrared sensor activated faucet with 0.5 GPM spray, grid drain, chrome finish.

4. Supplies:

    a. Acceptable Manufacturer: McGuire 170LK, or Brasscraft.
    b. 3/8 inch wall supplies, loose key angle stops, flexible tube riser, escutcheon, chrome finish.

5. Trap:

    a. Acceptable Manufacturer: McGuire 8872C or Brasscraft.
    b. 1-1/4 inch, 17 gage cast brass adjustable P-trap, cleanout plug, escutcheon, chrome finish.

6. Drain and Supply Line Covers:

    a. Acceptable Manufacturer: True Bro Model 102W or Prowrap.
    b. ADA compliant, flexible vinyl insulation installed on exposed drain piping, hot water piping and cold water piping.
    c. ANSI A117.1-2003.

7. Carrier:

    a. Acceptable Manufacturer: J.R. Smith 700, or Wade, Watts, Zurn, Josam, Mifab.
    b. Concealed arms with mechanical locking device, high strength steel uprights with block bases of bolting to floor construction.

8. Accessories: Point-of-use thermostatic mixing valve(s), where applicable, shall comply with ASSE 1070.

2.5 MOP RECEPTORS

A. Mop Receptor MR-1

1. Acceptable Manufacturer: Fiat, or Florestone, Stern-Williams.
2. Type: One piece precast terrazzo, integral cast drain, stainless steel protective cap on exposed sides, size as scheduled on Drawings.
3. Type: One piece molded construction, seamless, integral drain.

4. Faucet:

    a. Acceptable Manufacturer: T&S Brass B-0665-BSTR, or Chicago, Kohler.
    b. Polished chrome plated with vacuum breaker, lever handles, threaded spout, rubber hose, wall hook, loose key stops.

5. Accessories:

    a. Acceptable Manufacturer: Fiat, or Florestone, Stern-Williams.
    b. Mop Hanger: Stainless steel with three rubber tool grips.
    c. Wall Guard: Heavy gage stainless steel.

2.6 DRINKING FOUNTAINS

A. Drinking Fountain DF-1

1. Acceptable Manufacturer: Elkay LK4430BF1LFRK.
2. Type: Outdoor, free standing, tri-level pedestal with upper bottle filling station. Non-filtered, non-refrigerated, freeze proof, stainless steel, heavy duty, vandal resistant construction.
3. Color: Evergreen (EVG)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plumbing fixtures shall be installed square with wall, in line, and level, to give a uniform appearance. Plumbing trim and exposed supply and waste piping, including traps, shall be polished chrome plated brass, unless otherwise specified.

B. Drain and supply line covers shall be provided for all exposed plumbing (drain, tailpiece, trap, hot and cold water supplies, etc.) beneath ADA compliant lavatories and sinks.

C. Each hot and cold water connection to plumbing fixtures and equipment shall be valved, if not provided with integral stops as specified herein.

D. Calk space watertight between plumbing fixtures and wall or floor; silicone, white for all white fixtures, clear for all other colors.

E. Contractor shall be responsible to coordinate the orientation of all plumbing fixtures (i.e. left-hand, right-hand) with ADA requirements and general building conditions. Model numbers are listed for plumbing fixtures to illustrate a standard of quality for materials and indicate a specific style.

F. Contractor shall be responsible to coordinate carriers with chase dimensions and choose compact carriers where chase dimensions are narrow and free space will not accommodate standard size carriers.

G. Coordinate lavatory and sink hole drilling configurations with faucets.

3.2 TESTING

A. Plumbing fixtures shall be filled with water and checked for leaks or retarded flow. Remove and clean all aerators.

END OF SECTION

SECTION 22 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

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

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Approval in its "Approval Guide."
4) <**Insert name of qualified testing and inspecting agency**>.

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg. Select ratings below based on application.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg. Select ratings below based on application.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg. Select ratings below based on application.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

B. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

C. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

D. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

E. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

F. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

G. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Firestopping method for all penetrations containing low-voltage and control cabling shall allow for easy addition or replacement of cabling in future. Sealing sleeves or openings with single-use sealant is not acceptable.

3.4 IDENTIFICATION

A. Identification of penetrations is in addition to building code requirements for identification of fire and smoke barriers.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following minimum information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb" or similar.
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency, or permit agency.
4. Inspection/Permit number.
5. Date of installation.
6. Manufacturer's name.
7. Manufacturer's product.
8. Product UL or ASTM Listing.

C. Identification label shall be minimum 2 inches by 4 inches, white background with red warning text, with black indelible printing. Manufacturer specific labels are acceptable.

3.5 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM APPROVAL

1. Provide UL-classified systems. Refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

END OF SECTION

SECTION 23 00 00 - GENERAL PROVISIONS FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. 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.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 SUBMITTALS

A. Comply with Division 01 requirements for submittals.

B. Submit shop drawings and product data in PDF electronic format for approval to Engineer at shopdrawings@ba-inc.com.

C. Action Submittals 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 Engineer.

D. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include 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.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

E. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return to Contractor.

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

G. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

H. Each submittal shall contain shop drawings or product data for items in only one specification section. Submittals containing information about items from multiple specification sections will be returned without review.

I. Each submittal shall contain shop drawings or product data for all items in one specification section to be provided for this Project. Incomplete submittals are unacceptable and will be returned for resubmittal without review.

J. Engineer will return without review submittals received from sources other than Contractor.

K. Submittals not required by the Contract Documents will be returned by Engineer without review or action.

L. Clearly identify on each submittal specified items, accessories, and options, as applicable to this project. Catalog numbers, part numbers, etc. on submittals will not be reviewed for correctness. Submittals not clearly indicating only the items to be provided for this project will not be approved.

M. Submittal review by is for conformance with design concept of the Project and general compliance with information given in the construction documents. Approval, corrections and/or comments made as part of the submittal review do not relieve the Contractor of the responsibility from conformance with all requirements of the Contract Documents, applicable codes and laws. Contractor is responsible for dimensions, quantities, and performance requirements to be confirmed and correlated at the job site; for information that pertains solely to the fabrication processes or to techniques of construction; and for all coordination with the Work of all trades.

N. At the time of each submittal, Contractor shall give Engineer specific written notice of such variations, if any, that the Shop Drawing or product submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and sample submitted to Engineer for review and approval of each such variation.

O. Engineer's review and approval of Shop Drawings or products shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called the Engineer's attention to each such variation at the time of each submittal and Engineer has given written notation thereof incorporated in or accompanying the Shop Drawing or product approval; nor will any approval by Engineer relieve contractor from responsibility for complying with the requirements of this paragraph.

P. Shop drawing submittals shall be accompanied by a transmittal sheet with the applicable specification section number and the "name" of the item or items being submitted clearly indicated on the transmittal. All "names" on the transmittal shall match exactly the "names" listed in the specifications for the item being submitted.

Q. The name of the supplier, distributor, subcontractor, etc., who will furnish equipment and items to the Contractor shall appear on the shop drawings when submitted. Shop drawing submittals without supplier's, distributors, subcontractors, etc., name will not be reviewed and will be returned without review.

R. If Engineer is required to review any shop drawing or product data submittal more than two times, a Change Order will be issued to the Contractor for a credit due on the Contract Price to recoup Engineer's expenses associated with the multiple reviews.

S. Complete sets of approved shop drawings and product data, as required in Division 01, shall be delivered to Owner at completion of Work.

1.4 SUBSTITUTIONS

A. Comply with Division 01 requirements for substitutions.

B. Specifications for each piece of equipment and each item of material are written around a product of a specific base manufacturer. This base manufacturer is the basis of design, dimensions, and details. The basis of design manufacturer's name and model information are included with the product description as designated next to the manufacturer's name under the heading "Acceptable Manufacturers".

C. Substitution • manufacturers are defined as any manufacturer other than the one used as the basis of design. Substitution • manufacturers will be permitted, in accordance with the bidding requirements and where indicated herein.

D. Manufacturers named in the product description, in addition to the base manufacturer, are substitution manufacturers, have been determined to be manufacturers capable of manufacturing products similar to the base manufacturer and these manufacturers are acceptable substitution manufacturers to the base manufacturer. Where additional manufacturer's names do not appear with the base manufacturer, the reserves the right to disallow any substitution manufacturers. Where the base manufacturer's name is followed by the term "no substitution"””", no substitution manufacturers will be considered.

E. Naming of specific manufacturers shall not be construed as eliminating products or services of other substitution manufacturers having comparable items. Where permitted by these Specifications, and where Bidder desires to use other substitution manufacturers, they may submit a request for approval to use the substitution manufacturer in accordance with bidding requirements.

F. Products described in Specifications are intended to set a quality level and ensure a workable system. Substitution of manufacturers, including those herein named, may be made only after approval of Bidder shall assume full responsibility for installation and dimensional changes required by the use of all substitution manufacturer’’s products, including revisions to wiring, controls, piping, structural revisions, and all room or space changes as required due to dimension differences of the substitution manufacturer product. approval of substitution manufacturer’’s products shall be limited to compliance with information given on the Drawings and Specifications.

G. Where the Bidding requirements call for submittal for approval of substitutions prior to bids due, all approvals given are for substitution manufacturers only, not approval of any particular product. An approved substitution manufacturer’s product must comply with all requirements of the specifications and drawings for the base manufacturer’s product.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all materials and equipment as new, without imperfections or blemishes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Drawings are generally indicative of work to be installed but may not indicate all bends, fittings, boxes, etc. required to meet field conditions.

B. Coordinate installation of work of this Division with Work of other Divisions. Install in most direct manner possible to avoid interference between conduits, piping, ducts, equipment, and architectural or structural features. Work installed in an arbitrary manner without regard for Work of other Divisions will not be accepted.

C. Provide scaffolding and hoist or rigging materials as required for installation of Work of this Division.

D. Where equipment is furnished as Work of other Divisions for installation or wiring under Work of this Division, obtain and coordinate with approved shop drawings and installation instructions from respective contractor prior to rough-in.

E. Mechanical scope shown in each area of work shall be completed during construction phase as indicated on architectural phasing plans and/or phasing construction sequence narrative.

F. Codes and Standards:
1. Comply with all applicable local, state, national, and international codes and ordinances.
2. Reference to codes and standards listed herein shall constitute minimum acceptable requirements. Where Drawings and Specifications requirements exceed those of codes listed, Drawings and Specifications shall take precedence for Work of this Project.
3. Where applicable, materials and equipment shall bear the label of approval of Underwriters Laboratories, Inc.

G. Coordination - New Construction:

1. Openings and recesses in new construction (including cutting, patching, and finishing) necessary for installation of Work of this Division to be provided by General Contractor. Coordinate required locations, dimensional data, and scheduling of Work with General Contractor.

H. Coordination - Existing Construction:

1. Cut openings required in existing construction for installation of mechanical equipment, materials, and devices. Perform all cutting, patching, and refinishing as required to match surroundings.

2. Existing Ceilings: Remove existing ceiling tile where required for installation of mechanical Work. Reinstall existing ceiling tiles as Work is completed. All damaged or broken ceiling tile caused by Work of this Division shall be replaced at no cost to Owner.
3. Existing Raised Floor Panels: Remove existing raised floor panels where required for installation of mechanical work. Reinstall panels as Work is completed. All damaged or broken panels caused by Work of this Division shall be replaced at no cost to Owner.

I. Painting:

1. Equipment furnished under this Division that is pre-painted or pre-finished by manufacturer shall have all nicks, scratches, blemishes, and rust spots cleaned, primed, and refinished prior to final acceptance by Owner.
2. Painting shall be in accordance with the Division 09.
3. General Contractor will paint exposed unfinished equipment, conduit, supports and miscellaneous steel installed under this Division.

3.2 HAZARDOUS MATERIALS

A. Promptly notify Owner and if hazardous materials are observed in the structure or on the project site during the course of Work. Do not perform any work pertinent to the hazardous material prior to receipt of special instructions from the Owner. Hazardous materials • • are defined as asbestos, PCBs, petroleum, radioactive material, or hazardous waste substances.

3.3 CLEANING

A. Upon completion of Work, remove all dirt, foreign materials, stains, fingerprints, etc., from all parts and equipment.

B. Remove all construction debris and vacuum interior spaces of all compartmental equipment.

C. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

3.4 Work shall be subject to inspection by the PROTECTION FROM DUST AND DEBRIS

A. During patching, painting, ceiling removal and replacement, working on the ceiling or on things above the ceiling, etc., maintain cloths or suitable building paper covers to protect building surfaces. Protective measures (drop cloths, protective covers, etc.) shall be placed and sealed over all furniture and equipment to keep items clean and protected against dirt, dust and debris from entering furniture and equipment that the Owner has not removed.

B. Upon completion of work each day when building is occupied, remove all temporary covers, drop cloths, and debris and vacuum clean all worked-in areas to mitigate carrying of dirty materials and tracking dirt throughout building during time construction is not occurring.

END OF SECTION 23 00 00

SECTION 23 00 50 – HVAC BASIC MATERIALS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work of this Section shall consist of the labor, materials and equipment required for the installation of basic materials associated with HVAC systems.

1.2 SUBMITTALS

A. Submit for approval in accordance with specified submittal procedures:

1. Access Panels
2. Engineered Strut Support System; including structural calculations

PART 2 - PRODUCTS

2.1 ACCESS PANELS

A. Masonry, Tile or Wood Access Panels

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

   a. Bilco
   b. Karp
   c. Krieger
   d. Milcor (Basis of Design Style M)

2. Type: Masonry, tile, or wood.
3. Construction: 16 gage frame, 14 gage panel. Concealed spring hinges. Prime coat finish for field painting or stainless steel, satin finish, as required.
4. Closing Feature: Flush screwdriver operated lock with steel cam.

2.2 ENGINEERED STRUT SUPPORT SYSTEM

A. Acceptable Manufacturer: Unistrut Corporation, or as approved.

B. General: Provide all engineering, material, fittings, anchors, and related accessories for installation of the engineered strut support system. Submit structural calculations with design criteria, selection of framing members, fittings, accessories, and shop/assembly drawings.

C. Channel members shall be structural grade steel conforming to ASTM A-1011 SS GR or A-653 GR 33. Fittings shall be fabricated from steel conforming to ASTM A 575, A 576, A 36, or A 635. Components shall be finished with rust inhibiting acrylic enamel paint applied by electro-deposition.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Access Panels

1. Provide access panels in ceilings and walls for service and repair access to concealed equipment, including, but not limited to:

a. Dampers: volume, control, fire/smoke.
b. All control operators/devices.

Minimum Size: 18 inches by 18 inches. Where restrictions will not permit minimum size, verify access panel size with Architect. |END OF SECTION 23 00 50

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

1.4 SUBMITTALS

A. All motors provided by the Contractor shall be of the same manufacturer unless they are an integral part of the piece of equipment to which they are attached.

B. Product Data: Provide the following information for each motor:
1. Manufacturer.
2. Rated full load horsepower.
3. Rated volts.
4. Number of Phases.
5. Insulation Class.
6. Frequency in Hertz.
7. Full load amperes (FLA).
8. Locked rotor amperes (LRA) at rated voltage or NEMA code letter.
9. Nominal speed at full load (rpm).
10. Service factor.
11. NEMA design letter.
12. NEMA machine type (ODP, WP-I, TEFC, etc.).

C. For motors one horsepower and larger, include the following additional information:

1. NEMA frame size.

2. NEMA insulation system classification. For motors required to be installed outdoors, include information showing compliance for outdoor application.
3. Maximum ambient temperature for which motor is designed.
4. Time rating.
5. Bearing size and type data.
6. Guaranteed efficiency and power factor at full load, 75% load, 50% load, 25% load and 0% load.

D. For motors 20 horsepower and larger, include the following additional information:

1. No load amperes.
2. Safe stall time.
3. Guaranteed efficiency and power factor at full load, 75% load, 50% load, 25% load and 0% load.
4. Motor manufacturer¢s recommended maximum power factor correction capacitor (kvar) that can safely be switched with the motor.
5. Expected value of corrected power factor at no load, 50 percent, 75 percent and full load.
6. Full load amperes with corrected power factor.

7. Maximum guaranteed slip at full load.

E. Operation and Maintenance Data:

1. Submit operation and maintenance data including assembly Drawings, bearing data including replacement sizes, and lubrication instructions.

F. Alternate Motors:

1. If a motor horsepower rating larger than indicated is offered as a substitute and accepted, provide required changes in size of conductors, conduits, motor controllers, overload relays, fuses, circuit breakers, switches and other related items at no change in the Contract price.

1.5 WARRANTY

A. Provide minimum one-year manufacturer's warranty including coverage for motors one horsepower and larger.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ABB (Baldor-Reliance)
2. Nidec (Emerson, US Motor)
3. Seimens
4. Toshiba
5. Weg

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.3 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

1. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.4 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 284T and larger; rolled steel for motor frame sizes smaller than 284T.

2.5 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Inverter-Duty Motors: Class B temperature rise; Class H insulation.
3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
4. Shaft Grounding:

a. Helwig Carbon BPK Series carbon brush shaft grounding.
b. AEGIS Grounding Rings

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.6 SINGLE-PHASE MOTORS

A. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

E. ECM, where required in equipment specifications:

1. Variable-speed, DC, brushless motors specifically designed for use with single phase, 120 or 277 volt, 60 hertz electrical input.
2. Operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator.
3. Designed for synchronous rotation.
4. Permanent magnet type motor rotor with near zero rotor losses.
5. Able to be mounted with shaft in horizontal or vertical orientation.
6. Permanently lubricated with ball bearings.
7. Direct coupled to the blower.
8. Integral thermal overload protection.
9. Minimum of 70 percent efficiency over its entire operating range.
10. Anti-back rotation system or provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
11. Inductors to minimize harmonic distortion and line noise.

12. Motor control module:

    a. Built-in soft start and soft speed change ramps.
    b. Electronics and built-in surge protectors to protect the solid state controls from line transients.
    c. Variable speed mode to receive a variable control voltage signal from a DDC system in response to external PID outputs.

PART 3 - EXECUTION

3.1 APPLICATION

A. Motors located in exterior locations and in direct drive axial fans, roll filters, humidifiers and draw-through air units shall be totally enclosed weatherproof epoxy-sealed type.

B. Motors installed indoors must be open drip-proof (ODP) unless otherwise specified.

3.2 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Properly install and align motors after installation on the driven equipment.

D. Motor feeders shall be free of splices. In special cases when splice-free feeders are impractical, splices may be allowed given prior written approval from the Owner.

E. Use crimp-on, solderless copper terminals on the branch circuit conductors. For motors 20 horsepower and larger, use 5300 Series 3M motor lead splicing kit or approved equal.

F. When the motor and equipment are installed, the motor's nameplate must be in full view.

G. Where motor grease fittings are not accessible, extend 1/8" steel or copper tubing from fitting to an accessible location.

END OF SECTION

SECTION 23 05 48.13 - VIBRATION CONTROLS FOR HVAC

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. Elastomeric isolation mounts.
2. Open-spring isolators.
3. Restrained-spring isolators.
4. Elastomeric hangers.
5. Spring hangers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
3. Acoustical Treatment Materials: Submittal shall include construction details, materials, dimensions and attachment methods of individual components.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: ASHRAE Type 1.

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

   a. Amber Booth
   b. Kinetics Noise Control. Model NG or KIP (Basis of Design)
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads, where applicable.
8. Sandwich-Core Material: Resilient and/or elastomeric, per manufacturer's recommendation.

   a. Surface Pattern: Waffle pattern.
   b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: ASHRAE Type 2.

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

   a. Amber Booth
   b. Kinetics Noise Control. Model RD (Basis of Design)
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: ASHRAE Type 3.

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

   a. Amber Booth.
   b. Kinetics Noise Control. Model FDS (Basis of Design)
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.4 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: ASHRAE Type 4.

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

   a. Amber Booth.
   b. Kinetics Noise Control. Model FLS (Basis of Design)
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top plate with threaded mounting holes or elastomeric pad.
   c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.5 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: ASHRAE Type 2.

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

    a. Amber Booth.
    b. Mason Industries, Inc.
    c. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.6 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: ASHRAE Type 3.

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

    a. Amber Booth
    b. Kinetics Noise Control. Model SFH (Basis of Design)
    c. Mason Industries, Inc.
    d. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 SYSTEM DESIGN

A. Vibration isolation equipment manufacturer shall be responsible for proper selection of spring rates to accomplish the specified minimum static deflections for all spring and pad type isolators, based on weight distribution of equipment to be isolated.

B. Vibration isolation equipment manufacturer shall be responsible for structural design of steel beam and concrete inertia bases to support mechanical equipment specified herein.

3.3 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Rigid connections shall not exist between equipment and building structure that will degrade the sound and vibration control system(s) specified herein.

D. Sound and vibration control equipment and materials manufacturer, or his qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the sound and vibration control system. Upon completion of equipment installation and after the system is placed into operation, the manufacturer, or his representative, shall make a final inspection and submit a report to Architect in writing, certifying the correctness of the installation and compliance with Drawings and Specifications.

E. Piping and ductwork to be vibration isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping and ductwork, and maintain a minimum of 3/4 inch and a maximum of 1-1/4 inch clearance around the outside surfaces. Refer to Section 23 05 05 for procedures in sealing this annular space.

3.4 VIBRATION ISOLATION SCHEDULE

A. Equipment base type, isolator type, and minimum deflection rates shall be per 2019 ASHRAE Handbook - HVAC Applications, Table 47 "Selection Guide for Vibration Isolation", with notes. Spring rates shall be per equipment manufacturer and/or vibration isolation manufacturer recommendations.

B. Bases listed are in addition to any housekeeping pad requirements.

C. Do not add additional isolation to internally-isolated equipment unless directed by the manufacturer.

D. Axial Fans, Plenum Fans, Cabinet Fans, Fan Sections, Centrifugal Inline Fans

1. Up to 22" diameter:

a. Slab on grade:

1) No base, Isolator attached directly to equipment.
2) Elastomeric Isolation Mount or Elastomeric Hanger.

b. All floor spans:

1) No base, Isolator attached directly to equipment.
2) Spring Isolator or Spring Hanger.

2. 24" diameter and larger:

a. 2" Total Static Pressure and less, slab on grade and floor span:

1) Structural steel or base rails.
2) Spring Isolator or Spring Hanger.
3) Exceptions:

a) 300 RPM and less, all floor spans, concrete inertia base required.
b) 301 to 500 RPM, spans over 20 feet, concrete inertia base required.

b. 2.1" Total Static Pressure and greater:

1) Concrete Inertia Base.
2) Spring Isolator or Spring Hanger.

E. Condensing Units

1. Slab on grade:

a. No base, Isolator attached directly to equipment.
b. Elastomeric Isolation Pad.

2. Spans up to 30 feet:

a. No base, Isolator attached directly to equipment.

b. Restrained Spring Isolator.

3. Spans over 30 feet.

a. No base, Isolator attached directly to equipment or curb mounted-base.
b. Spring Isolator or Spring Hanger.

F. Packaged Air Handling, Air Cooling, Heating and Ventilating Units

1. 10 hp and less:

a. No base, Isolator attached directly to equipment.
b. Spring Isolator or Spring Hanger.

G. Ductwork and Piping, where noted.

1. Spring Hangers

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Duct labels.
5. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving,1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-taping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

A. Material: Vinyl.

B. Minimum Thickness: 0.005 inch.

C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

E. Maximum Temperature: 160 deg F.

F. Minimum Width: 2 inches.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:

1. Duct size.
2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

A. Stencils for Ducts:

1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances of up to 15 ft. and proportionately larger lettering for greater viewing distances.
2. Identification Paint: Exterior, acrylic enamel . Paint may be in pressurized spray-can form.
3. Letter and Background Color: Color as indicated for specific application under Part 3.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

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 identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of mechanical equipment.

B. Sign and Label Colors:

1. Non-emergency powered equipment: White letters on a black background.
2. Emergency powered equipment: White letters on a black background.

C. Locate equipment labels where accessible and visible.

D. Provide plastic labels on equipment with surface temperatures less than 150 degrees F.

E. Provide metal labels on equipment with surface temperatures equal to or greater than 150 degrees F.

F. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.

B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.

C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF DUCT LABELS OR STENCILS

A. Install self-adhesive duct labels or paint stencils showing service and flow direction with permanent adhesive on air ducts.

1. Provide labels in the following color codes:

a. For air supply ducts: White letters on blue background.
b. For air return ducts: White letters on green background.
c. For general exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on green background.

B. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.

3.6 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where scheduled.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. General: TAB Firm shall check, adjust, and balance components of the HVAC systems which will result in optimal noise, temperature, and airflow conditions in the conditioned spaces of the building while the system equipment is operating economically and efficiently. This is intended to be accomplished after the system components are installed and operating as specified in the Contract Documents.

1. It is the responsibility of the HVAC and/or Control Systems Contractor to place the equipment into service.
2. During the balancing process, as the TAB Firm discovers abnormalities and malfunctions of equipment or components, the TAB Firm shall advise the HVAC and/or Control Systems Contractor in writing so that the condition can be corrected by the Contractor prior to finishing the TAB scope of Work. Data from malfunctioning equipment shall not be recorded in the final TAB report.

B. Liaison and Early Field Inspection: TAB Firm shall act as a liaison between the Owner, Architect and Contractor. During construction, review all HVAC submittals such as control diagrams, air handling devices, etc., that pertain to the ability to satisfactorily balance systems and advise in writing accordingly.

C. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
2. Testing, Adjusting, and Balancing Primary Equipment:
    a. Motors.
3. Duct leakage tests.
4. Control system coordination and verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Penn State University, Harrisburg Campus after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. At the Owner’s option, all data sheets tabulated each day by TAB Firm personnel shall be submitted for review and sign-off by the Owner’s Construction Inspector. Those data sheets, as initialed by Owner’s Construction Inspector, shall be presented as a supplement to the final TAB report.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.

2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. Testing, adjusting, and balancing (TAB) of the HVAC systems and related ancillary equipment will be performed by a technically qualified TAB Firm. TAB Firm shall be capable of performing the TAB services as specified in accordance with the Contract Documents, including the preparation and submittal of a detailed report of the actual TAB Work performed.

B. TAB Firm shall have operated a minimum of five (5) years under TAB Firm's current name and shall be in good standing with the State of Pennsylvania. TAB Firm shall submit full incorporated name, Charter Number, and Taxpayer's I.D. Number for proper verification of TAB Firm's status.

C. TAB Firm's personnel performing Work at the Project Site shall be either professional engineers or certified air and water balance technicians, who shall have been permanent, full time employees of the TAB Firm for a minimum of six (6) months prior to the start of Work for this Project.

D. TAB firm shall have a background record of at least five (5) years of specialized experience in the field of air and hydronic system balancing and shall possess properly calibrated instrumentation.

E. TAB Contractor required Qualifications: Certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.

F. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

G. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

H. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

I. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been made at the Project Site by the permanently employed technicians or engineers of the TAB Firm.

J. TAB scope is not complete until all issues are resolved to University's satisfaction.

1.7 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and remainder of existing building during entire TAB period. Only the areas specifically designated to be renovated shall not regularly be occupied by Owner during the construction phase. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements defined in air duct accessories specifications.
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to requirements of insulation specifications.

C. All instruments used for measurements shall be accurate, and calibration histories for each instrument shall be available for examination. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC or NEBB.

D. Accuracy of measurements shall be in accordance with AABC or NEBB Standards.

E. In addition, the Contractor shall check the operation of all automatic temperature control equipment; verify all thermostat, aquastat, airstat, etc., set-points and operations; and enlist the aid of the control Subcontractor to make necessary adjustments where required.

F. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

G. Take and report testing and balancing measurements in inch-pound (IP) units.

H. Coordinate with Controls Contractor as required to establish and document balanced positions and set points for damper and valve actuator position.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in ductwork specifications.

M. It is unacceptable for balancing contractor to indicate that a system has been balanced as far as the existing sheaves permit. Coordinate with HVAC Contractor to change pulleys, belts, sheaves, etc., as required.

N. All adjustable sheaves shall be replaced with suitable fixed sheaves prior to final acceptance by the University.

O. When room air pressurization relationships are specified or required by code, confirm proper balance of airflows and pressurization with respect to adjacent rooms and corridors.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect/Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.

2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.7 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.8 CONTROL SYSTEMS COORDINATION AND VERIFICATION

A. In the process of HVAC system Testing, Adjusting and Balancing, perform the following:

1. Work with the Building Automation System (BAS) Provider and Owner to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of intended control performance.

2. Verify temperature control system is operating within the design limitations.
3. Confirm that the sequences of operation are in compliance with Contract Documents.
4. Verify that controllers and any air and water flow measuring devices are calibrated and function together as intended.
5. Observe the calibration and operation of all controllers.
6. Verify that controller set points are as indicated.
7. Verify the operation of lockout or interlock systems.
8. Verify the operation of valve and damper actuators.
9. Verify that controlled devices are properly installed and connected to correct controller.
10. Verify that the intended controllers operate all dampers, valves and other controlled devices.
11. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
12. Verify the proper application of all normally opened and normally closed valves.
13. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure. Check for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
14. Observe the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. BAS Provider will relocate sensors as deemed necessary by the TAB Firm or Contractor.
15. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open positions. This includes all duct-mounted dampers, dampers in terminal units, and fire/smoke dampers.
16. Verify that the sequence of operation for any control mode is in accordance with approved Shop Drawings and Specifications. Verify that no demand for simultaneous heating and cooling occurs at the terminal units.
17. Perform variable volume system verification to assure the system and system components track with changes from full flow to minimum flow.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

C. During the balancing process, as the TAB Firm discovers abnormalities and malfunctions of equipment or components, the TAB Firm shall advise the HVAC and/or Control Systems Contractor in writing so that the condition can be corrected by the Contractor prior to finishing the TAB scope of Work. Data from malfunctioning equipment shall not be recorded in the final TAB report.

3.9 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: minus 0 or plus 10 percent.
2. Air Outlets and Inlets: minus 0 or plus 10 percent.
3. Heating-Water Flow Rate: minus 0 or plus 10 percent.
4. Cooling-Water Flow Rate: minus 0 or plus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. An electronic document of the final report shall be submitted on applicable AABC or NEBB Reporting Forms for review and approval by the Professional and University.

a. Each electronic document shall be intuitive, fully-organized, with selectable table of contents that includes tabs and/or bookmarks linked to be able to skip directly to each associated section.
b. **All documents shall be fully text searchable**. Use electronically created and populated forms and systems diagrams.
c. When scanning of paper originals is a necessary last resort, it shall be done with optical character recognition (OCR) technology. Verify that all pages on every document have been scanned. Review each page to ensure that the scan captures original detail. If images appear too dark or too light, or smudged, rescan the page to ensure proper image quality and legibility. Color charts or other documents where color is required to convey full information shall be scanned in color.
d. Coordinate with the Office of Physical Plant’s Facility Asset Management (FAM) Program, Document Management Subdivision, for electronic submission requirements, including file naming structure guidelines. Contact List:

1) Craig Dubler, FAM Program Manager, crd137@psu.edu, (814) 865-0089
2) Ken Vasko, Facilities Specialist, kev12@psu.edu, (814) 863-4564

B. Each individual final Reporting Form submitted must bear the signature of the person who recorded the data and the signature of the testing and balancing supervisor of the performing firm.

C. If more than one certified firm performs the TAB work, all final reports shall be submitted by that firm having managerial responsibility.

D. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

E. Include a list of instruments used for procedures, along with proof of calibration including dates of calibration to be submitted with the final report.

F. Certify validity and accuracy of field data.

G. The final test report shall include appropriate reference to all problems regarding the system(s) encountered prior to, during and after testing and what action taken to correct the problems (s), including noise and vibration.

H. An approved copy of the balancing report shall be included in the Maintenance Manual submittal.

I. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

J. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

K. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows including system total airflow rates.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

L. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

    a. System identification.
    b. Location.
    c. Coil identification.
    d. Capacity in Btu/h.
    e. Number of stages.
    f. Connected volts, phase, and hertz.
    g. Rated amperage.
    h. Airflow rate in cfm.
    i. Face area in sq. ft..
    j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

    a. Heat output in Btu/h.
    b. Airflow rate in cfm.
    c. Air velocity in fpm.
    d. Entering-air temperature in deg F.
    e. Leaving-air temperature in deg F.
    f. Voltage at each connection.
    g. Amperage for each phase.

M. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches, and bore.
    h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.
f. For variable speed systems, document VFD frequency at design airflow
g. Center-to-center dimensions of sheave, and amount of adjustments in inches.
h. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

N. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

O. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

P. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.12 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect/Engineer.

B. Architect/Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Architect/Engineer may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13 - DUCT INSULATION

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

1. Indoor, exposed outdoor air.

B. Related Sections:

1. Section 23 07 16 "HVAC Equipment Insulation."
2. Section 23 07 19 "HVAC Piping Insulation."
3. Section 23 31 13 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Insulation materials shall be made of FM Approved Class 1 materials, or noncombustible materials.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

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

    a. Aeroflex USA, Inc.
    b. Armacell LLC. (Basis of Design, Arma Tuff)
    c. K-Flex USA.

2. Thermal Conductivity (k-value) at 75 deg F and 1.0 lb per sq.ft. is 0.25 Btu*in/hr*ft2*°F.
3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thicknesses of up to 1 inch as tested in accordance with ASTM E84.

4. Exterior Application Jacket: 12 mil UV resistant.

    a. Multiple layers: Substrate layers do not have jacket.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. CertainTeed Corporation.
    b. Johns Manville; a Berkshire Hathaway company. (Basis of Design, Microlite)
    c. Knauf Insulation.
    d. Owens Corning.

2. Thermal Conductivity (k-value) at 75 deg F and 1.0 lb per sq.ft. is 0.27 Btu*in/hr*ft2*°F.
3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thicknesses of up to 1 inch as tested in accordance with ASTM E84.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. CertainTeed Corporation.
    b. Johns Manville; a Berkshire Hathaway company. (Basis of Design, 814 Spin-Glas)
    c. Knauf Insulation.
    d. Owens Corning.

2. ThermalConductivity (k-value) at 75 deg F and 3.0 lb per sq.ft. is 0.23 Btu*in/hr*ft2*°F.
3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thicknesses of up to 1 inch as tested in accordance with ASTM E84.

J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. CertainTeed Corporation.
    b. Johns Manville; a Berkshire Hathaway company. (Microflex)
    c. Knauf Insulation.(Basis of Design, Earthwool Pipe and Tank)
    d. Owens Corning. (Fiberglas Pipe and Tank w/ ASJ Max

2. Thermal Conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F
3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thicknesses of up to 1 inch as tested in accordance with ASTM E84.

K. Polyisocyanurate: Preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation. Comply with ASTM C1289.

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

   a. Carlisle Construction Materials.
   b. GAF.
   c. Johns Manville: a Berkshire Hathaway company. (Basis of Design, XSPECT Isofoam.)
   d. RMax.

2. Preformed insulation, with factory-applied foil face.,
3. Thermal conductivity (k-value) shall not exceed 0.16 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
4. Flame-spread index shall be 25 or less, and smoke-developed index shall be 450 or less for thicknesses of up to 1 inch as tested in accordance with ASTM E84.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

B. Mineral-Fiber Adhesive:

1. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

1. VOC Content: 300 g/L or less.

B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: Comply with ASTM C 755, Section 7.2.2, Table 2, for insulation type and service conditions.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White.

2.4 SEALANTS

A. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. Sealant shall have a VOC content of 420 g/L or less.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Self-Adhesive Outdoor Jacket:

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

   a. 3M Products. (Ventureclad 1579 Series)
   b. Alumagaurd
   c. Flexclad (Flexclad 400)

2. Minimum 45-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing. Color and finish per schedule.
3. 16-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a acrylic adhesive resin on a multilayered laminate covered with aluminum-foil facing. Color and finish per schedule.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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

   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. Compac Corporation.
   c. Ideal Tape Co., Inc., an American Biltrite Company.
   d. Knauf Insulation.
   e. Venture Tape.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.8 SECUREMENTS

A. Bands:

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
b. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel where stainless cladding is utilized.

2.9 CORNER ANGLES

A. PVC Corner Angles: 0.040 inches thick, minimum 1 by 1 inch or 1-1/2 inches by 1-1/2 inches, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316 to match cladding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 incheso.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
1. Indoor, exposed outdoor air.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. General exhaust not listed above.
9. Outdoor, exposed outside air duct.
10. Outdoor, concealed outside air duct.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.0-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2.0-lb/cu. ft.nominal density.

B. Exposed, rectangular, exhaust-air duct insulation between isolation damper and exterior of the building shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.0-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2.0-lb/cu. ft.nominal density.

END OF SECTION

SECTION 23 09 10 **–** BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work under this Section shall consist of the labor, materials and equipment required for installation of the building automation system and automatic temperature control system (BAS/ATC).

1.2 SUBMITTALS

A. Submit complete BAS/ATC shop drawings for Engineer's approval prior to installation or fabrication of any equipment. Submittal data shall include a schedule of all devices to be installed, including proposed locations. Devices shall be properly sized and selected for optimum system operation.

B. Deviations from the sequence of control specified herein shall be clearly noted in the sequence of control furnished with shop drawing submittals.

C. Submittals shall include software, control equipment, control valves, motor-operated dampers, damper actuators, sequence of operations, points list, complete system drawings, etc.

1.3 QUALITY ASSURANCE

A. The BAS/ATC system shall be designed, installed, commissioned and serviced by factory trained personnel.

1.4 SERVICE AND GUARANTEE

A. At completion of system installation, BAS/ATC system manufacturer shall adjust all thermostats, control valves, motors and other equipment provided under this contract with trained personnel in the direct employ of BAS/ATC system manufacturer. He shall place said equipment in complete operating condition subject to approval of Engineer, and instruct Owner's operating personnel in the operation of the system.

B. BAS/ATC system, as shown on Drawings and specified herein, shall be guaranteed free from defects in workmanship and material under normal use and service for a period of 1 year after acceptance by Owner.

C. Equipment herein described proven to be defective in workmanship or material during the guarantee period shall be adjusted, repaired, or replaced by BAS/ATC system manufacturer at no charge to Owner.

D. BAS/ATC system manufacturer shall maintain an up to date software program to provide Owner with backup in the event of system failure at any future date.

1.5 WIRING

A. All power and wiring required by the BAS/ATC system, controllers and required appurtenances shall be provided by BAS/ATC system supplier.

B. Detailed wiring diagrams and complete field supervision shall be provided by system installer.

C. System installer shall furnish and install control devices specified in this Section unless specifically stated otherwise.

D. Maximum allowable voltage for wiring inside control panels shall be 120V.

E. All wiring shall conform to the National Electrical Code and requirements of Division 26.

F. Control wiring penetrations at wall-mounted sensors shall be calked and sealed to prevent air leakage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design, to match existing system: Siemens.

B. Substitutions: None.

2.2 GENERAL

A. BAS/ATC system shall include, but not be limited to, the following components:

1. System application controllers shall manage the energy and building management capacities of the automation system, as well as, facilitate remote communications and central monitoring.
2. Application specific controllers shall provide distributed, pre engineered control, specific to the mechanical equipment specified.
3. Custom application controllers with distributed custom programming capability shall provide control for nonstandard control sequences.
4. Data communications capability shall allow data to be shared between the various controllers in the architecture.
5. System software shall include system software for global application functions, application software for distributed controllers, and operator interface software.
6. End devices such as sensors, actuators, dampers, valves, and relays.
7. Update software graphics for added and modified systems.

B. The failure of any single component shall not interrupt the control strategies of other operational devices. System expansion shall be through the addition of end devices, controllers, and other device specified herein.

2.3 SYSTEM APPLICATION CONTROLLERS

A. BAS/ATC system shall be composed of one independent, stand alone, microprocessor based system application controller to manage the global strategies described in application software section.

B. System application controller shall have ample memory to support its operating system, database, and programming requirements.

C. Operating system of the system application controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

D. Data shall automatically be shared between system application controllers when they are networked together.

E. Database and custom programming routines of remote system application controllers shall be editable from single operator station.

F. System applications controllers shall have the capability of being remotely monitored over telephone modem. Additional capabilities shall include automatically dialing out alarms, gathering alarms, reports and logs, programming an downloading databases.

G. Controller shall continually check status of all processor and memory circuits. If a failure is detected, controller shall:

1. Assume a predetermined failure mode.
2. Emit an alarm.
3. Display card failure identification.

2.4 APPLICATION SPECIFIC CONTROLLERS

A. Application specific controllers shall be stand alone, microprocessor based direct digital controllers with sufficient memory to handle its operating system, database and programming requirements.

B. Application specific controller shall be pre programmed, tested, and factory mounted on mechanical equipment to ensure reliability.

1. Where factory mounting is not possible, controllers shall be factory programmed and tested prior to shipment to jobsite. Controllers shall be clearly labeled as to controller type, where installed, and software address (if applicable). Controller shall be fully tested upon installation to ensure that it is properly matched to the equipment it is controlling.

C. Controller shall communicate with other devices on communication network and be fully integrated with other system components.

D. Hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at minus 40 degrees F to 155 degrees F.

2. Controller used in conditioned ambient shall be mounted in dust proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F.

2.5 CUSTOM APPLICATION CONTROLLERS

A. Custom application controllers shall provide stand alone control and require no additional system components for complete operation. It shall have sufficient memory to support its operating system, database, and programming requirements.

B. All programming required for operation shall be memory resident and shall be retained in permanent memory. Battery backup for a minimum of 72 hours is also permissible.

C. Custom application controller shall be configured such that portable operator interface can be plugged directly into it or within sight for programming, editing, and other operator functions.

D. Controller hardware shall be suitable for the anticipated ambient conditions.

E. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at minus 40 degrees F to 155 degrees F.

F. Controller used in conditioned ambient shall be mounted in dust proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F.

2.6 INPUT/OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into system through system application, or application specific controllers. Slave devices are also acceptable. Any critical points requiring immediate reaction shall be tied directly into controller hosting control software algorithm for critical function.

B. Binary inputs shall allow monitoring of on off signals from remote devices. Binary inputs shall provide a wetting current of 12MA at 12VDC to be compatible with commonly available control devices.

1. All status points shown on point list shall be positive proof differential pressure or current sensing binary switches.

C. Analog inputs shall allow the monitoring of low voltage, current, or resistance signals and shall have a minimum resolution of 0.1 percent of sensing range. Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

D. Binary outputs shall provide a continuous low voltage signal for on off control of remote devices. Where specified in sequence of operations or indicated on points list, binary outputs shall have 3 position on off auto override switches, status lights, and shall be selectable for either normally open or normally closed position.

E. Analog outputs shall provide a modulating signal for control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 milliampere signal as required to provide proper control of output device.

F. System architecture shall allow for point expansion in one of the following ways:

1. Addition of input/output cards to an existing system application controller.

2. A slave controller may be used to expand point capacity.
3. 10 percent expansion capacity for all point types in all DDC panels.

2.7 TEMPERATURE SENSORS

A. Temperature sensors shall be integrated circuit temperature detector sensors (RTD) or thermistor as dictated by requirements herein.

B. Immersion sensors shall be provided with a separable stainless steel well.

C. Space sensors shall be equipped with setpoint adjustment and/or override switch as specified on the Drawings or in the sequence of operations.

D. Accuracies shall be plus or minus 1 degree F for standard applications. Where high accuracy is required, accuracies shall be plus or minus.2 degrees F.

PART 3 - EXECUTION

3.1 MOUNTING HEIGHTS

A. Mounting height for space sensors and thermostats shall be 44 inches from the finished floor to the centerline of the device. If the designated location of a device places it partially between two finishes, the actual location shall be adjusted to set the device entirely on one finished surface only, but actual height shall not exceed mounting heights indicated or required by codes.

PART 4 - SEQUENCE OF OPERATION

4.1 ENERGY RECOVERY VENTILATOR AND ASSOCIATED ELECTRIC DUCT COIL

A. The system shall consist of the following components: supply fan, electric heating coil, outside air damper, exhaust fan, enthalpy wheel, exhaust damper, and recirculation/return damper.

B. A signal from the BAS/ATC system shall index the unit to occupied/unoccupied, heating and cooling, cycles from commands from the building automation system via the communications network. In the event of loss of communication with the building automation system, the unit controller shall automatically transfer control setpoints for heating, cooling and night setback to the default values programmed at the controller

C. Occupied Mode: Unit shall energize during occupied mode. Fans shall be energized, outside air and exhaust air dampers shall open, wheel shall rotate.

1. Cooling Mode: Fan shall operate to maintain space temperature setpoint (75 Degrees F Adjustable). When space temperature is met, the fan shall be de-energized.

2. Heating Mode: On a drop in space temperature below heat setpoint (70 Degrees F Adjustable). The units fan be energized and electric duct coil shall be staged to maintain space temperature. When space temperature rises above setpoint the unit fan and electric duct coil shall be de-energized.

a. Alarm on low space temperature below setpoint for more than 15 minutes (Adjustable).

D. Unoccupied Mode: Unit fans shall be off and system de-energized until the space temperature setpoints are no longer satisfied. Upon space temperature outside of the unoccupied setpoint, the unit outside air and exhaust dampers shall open, fans shall run and system shall be energized to maintain setpoint. Upon meeting space temperature setpoint, the system shall de-energize.

E. Monitor and trend unit discharge air temperature.

F. Safeties: BAS/ATC shall turn off the unit and an alarm shall be reported to the operator interface if any of the following conditions occurs:

1. Fan status for the outside air fan, exhaust air fan and enthalpy wheel motor shall be provided by a current sensing relay. An alarm shall be generated at the BAS/ATC Operator Interface when fan is commanded on, but status indicates fan is off.
2. Detection of supply air temperature below 40 degrees F (adjustable).

G. Factory Frost Control: shall modulate the energy wheel speed to control frost occurring on the energy wheel.

4.2 FAN (F-1)

A. Controlled by line voltage thermostat maintain space temperature.

4.3 ELECTRIC UNIT HEATERS (UH-1 through UH-4)

A. Operate to maintain space temperature. No work for BAS contractor.

END OF SECTION

SECTION 23 09 23.12 - CONTROL DAMPERS

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 the following types of control dampers and actuators for DDC systems:

1. Rectangular control dampers.
2. General control-damper actuator requirements.
3. Electric and electronic actuators.

B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 23.12.

1.3 DEFINITIONS

A. DDC: Direct-digital control.

B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.

E. Environmental Conditions:

1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

    a. Hazardous Locations: Explosion-proof rating for condition.

F. Selection Criteria:

1. Fail positions unless otherwise indicated:

    a. Supply Air: Open.
    b. Return Air: Open.
    c. Outdoor Air: Close.
    d. Mixed Air: Open.
    e. Exhaust Air: Close.

2. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
3. Select modulating dampers for a pressure drop of 5 percent of fan total static pressure unless otherwise indicated.
4. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.

B. Rectangular Dampers with Aluminum Airfoil Blades:

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. Greenheck; VCD 42.
   b. Ruskin Company; CD50 Series (Basis of Design).

2. Performance:

   a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
   b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
   c. Velocity: Up to 6000 fpm.
   d. Temperature: Minus 40 to plus 185 deg F.
   e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
   f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

   a. Frame:

      1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
      2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
      3) Width not less than 5 inches.

   b. Blades:

      1) Hollow, airfoil, extruded aluminum.
      2) Parallel or opposed blade configuration as required by application.
      3) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.07 inch thick.
      4) Width not to exceed 6 inches.
      5) Length as required by close-off pressure, not to exceed 48 inches.

   c. Seals:

      1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
      2) Jambs: Stainless steel, compression type.

   d. Axles: 0.5-inch- diameter plated steel, mechanically attached to blades.
   e. Bearings:

      1) Molded synthetic or stainless-steel sleeve mounted in frame.

2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and plated steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

C. Insulated Rectangular Dampers:

1. Products: Subject to compliance with requirements, provide products by one of the following:

a. Greenheck.
b. Pottorff
c. Ruskin TED50. (Basis of Design)
d. TAMCO (T. A. Morrison & Co. Inc.); 9000ECT.

2. Performance:

a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure and shall not exceed 4.9 cfm/sq. ft. against 4-in. wg differential static pressure at minus 40 deg F.
b. Pressure Drop: 0.1-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
c. Velocity: Up to 4000 fpm.
d. Temperature: Minus 100 to plus 185 deg F.
e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

a. Frame:

1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.08 inch thick.

2) C-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
3) Width not less than 4 inches.
4) Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.
5) Damper frame shall be insulated with polystyrofoam on four sides.

b. Blades:

1) Hollow shaped, extruded aluminum.
2) Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
3) Parallel or opposed blade configuration as required by application.
4) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.08 inch thick.
5) Width not to exceed 6 inches.
6) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals: Blade and frame seals shall be of flexible silicone and secured in an integral slot within the aluminum extrusions.
d. Axles: 0.44-inch- diameter plated or stainless steel, mechanically attached to blades.
e. Bearings:

1) Bearings shall be composed of a Celcon inner bearing fixed to axle, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and plated or stainless steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

I. Actuator Fail Positions as indicated below:

1. Exhaust Air: Close Last position Open.
2. Outdoor Air: Close Last position Open.

2.4 ELECTRIC AND ELECTRONIC ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. 24 V unless otherwise noted.
2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up 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.
3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Position Feedback:

1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

G. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

H. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

I. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

J. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

K. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 1 or 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

L. Stroke Time:

1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 60 seconds.
3. Move damper to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

M. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

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

3.2 CONTROL-DAMPER APPLICATIONS

A. Control Dampers:

1. Damper and acuators shall be selected to operate in the environment where they are located. Follow manufacturer recommendations for harsh environments.

B. Select from damper types indicated in "Control Dampers" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

1. Rectangular Outdoor Air Duct Applications with SMACNA Construction Class IA and Velocities to 3000 fpm: Insulated rectangular dampers.

3.3 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:

1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.4 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.5 CONTROL DAMPERS

A. 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.

B. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

C. Service Access:

1. Dampers and actuators shall be accessible for visual inspection and service.
2. 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 Section 23 33 00 "Air Duct Accessories."

D. 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.

E. Attach actuator(s) to damper drive shaft.

F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.6 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with damper identification on damper.

3.8 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
4. Verify that control dampers are installed correctly for flow direction.
5. Verify that proper blade alignment, either parallel or opposed, has been provided.
6. Verify that damper frame attachment is properly secured and sealed.
7. Verify that damper actuator and linkage attachment are secure.
8. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
9. Verify that damper blade travel is unobstructed.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Sealants and gaskets.
3. Hangers and supports.

B. Related Sections:

1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 31 16 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. Minimum thickness: 26 gauge.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
3. Where specified for specific applications, all joints shall be welded.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.

1. Where specified for specific applications, all joints shall be welded.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

D. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.4 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT CONSTRUCTION

A. Fabricate ducts with indicated dimensions for clear internal dimensions.

1. Unless otherwise indicated, the net free area of the duct dimensions given on the contract drawings shall be maintained. The duct dimensions shall be increased as necessary to compensate for liner thickness.

3.2 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of four segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

a. Elbows must be gored or welded, adjustable elbows are unacceptable.

N. Branch Connections: Use lateral or conical branch connections.

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

3.8 STARTUP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
2. Minimum duct thickness for any application is 26 gauge.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, Downstream of Variable Air Volume Boxes and Terminal Units

a. Pressure Class: Positive 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2- inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2- inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 8.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

    a. Exposed to Airstream: Match duct material.
    b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminum.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

        1) Radius-to Diameter Ratio: 1.5.

    b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm: Conical tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

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. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Louvers.
5. Turning vanes.
6. Duct-mounted access doors.
7. Duct access panel assemblies.
8. Flexible connectors.
9. Duct accessory hardware.
10. Take off fitting

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 3 or 4 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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

    a. Aire Technologies.
    b. American Warming and Ventilating; a Mestek Architectural Group company.
    c. Flexmaster U.S.A., Inc.
    d. Flex-Tek Group.
    e. McGill AirFlow LLC.
    f. Nailor Industries Inc.
    g. Pottorff.
    h. Ruskin Company.
    i. Trox USA Inc.
    j. Vent Products Co., Inc.
    k. Young Regulator Company. (Basis of Design)

2. For rectangular duct, opposed blade volume dampers constructed with triple V-blades, hat channel frame with linkage concealed in frame. For round duct, single blade volume dampers with linkage outside the fram.
3. Operating temperature: minus 40 degrees F to 180 degrees F. Maximum system pressure 5-inches wg.
4. Suitable for horizontal or vertical applications.
5. Materials to match duct system where dampers are installed.
6. Frames:

    a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel or 0.05-inch- thick stainless steel or 0.10-inch- thick, aluminum sheet channels.
    b. Mitered and welded corners.
    c. Flanged connections

7. Blades:

    a. Multiple or single blade.
    b. Opposed-blade design for multiple blade dampers.
    c. Stiffen damper blades for stability.
    d. Galvanized or Stainless-steel, 0.064 inch thick or Extruded-Aluminum, 0.050-inch-thick.

8. Blade Axles: Galvanized steel, Stainless steel or Nonferrous metal to match installed duct system.
9. Bearings: Molded synthetic.
10. Tie Bars and Brackets: Galvanized steel, Stainless steel or Aluminum to match installed duct system.
11. Maximum single section damper size: 48 inch by 48 inch. For larger duct sizes furnish multiple damper sections.
12. Furnish damper with adjustable quadrant regulator and lock.
13. On externally-insulated ducts, mount quadrant regulators on stand-off brackets to accommodate thickness of insulation.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 LOUVERS

A. Stationary Waterproof Louver

1. Acceptable Manufacturer: American Warming & Ventilating, or Louvers and Dampers, Airstream, Ruskin, Pottorff.
2. Construction: 6 inch deep all welded extruded aluminum.
3. Frame: Not less than .081 inch thick 6063 T5 alloy.
4. Blades: 3-1/2 inch to 4-1/2 inch centers with two reinforcing V's and integral downspouts to drain water from louver blades.
5. Finish: Kynar 500, color as selected by Architect.
6. Certification: AMCA certified for air and water penetration.
7. Accessories: 1/2 inch mesh aluminum birdscreen.

2.5 TURNING VANES

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Hardcast, Inc.
5. METALAIRE, Inc.
6. SEMCO LLC.
7. Ward Industries; a brand of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 incheswide and double wall for larger dimensions. Vanes shall be securely fastened to runners and runners securely fastened to ductwork. For lined ductwork, runners shall be raised hat style to prevent damage to duct liner. Turning vanes greater than 36 inches in lenght shall be braced at intermediate points with tie rods.

2.6 DUCT-MOUNTED ACCESS DOORS

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. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a divsion of MESTEK, Inc. (Basis of Design, HDD)
4. CL WARD & Family Inc.
5. Ductmate Industries, Inc.
6. Elgen Manufacturing.
7. Flexmaster U.S.A., Inc.
8. Greenheck Fan Corporation.
9. McGill AirFlow LLC.
10. Nailor Industries Inc.
11. Pottorff.
12. Ventfabrics, Inc.
13. Ward Industries; a brand of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
d. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two cam locks.
b. Access Doors up to 18 InchesSquare: Continuous hinge and two cam locks.
c. Access Doors up to 24 by 36 Inches: Continuous hinge and two cam locks.

2.7 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc. (Basis of Design)
3. Elgen Manufacturing.
4. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone or Durolon.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 225 lbf/inch in the warp and 300 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 250 deg F.

2.8 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.9 TAKE OFF FITTINGS FOR ROUND FLEXIBLE DUCTWORK

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

1. Buckley Associates, Inc.
2. Ductmate Industries, Inc.
3. Flexmaster USA (Basis of Design SOG)

B. Spin-in fitting with straight collar manufactured to SMACNA Standards for commercial construction. Contains 1-inch (25-mm) flange and stick on gasket for attachment to duct main.

1. Where duct height will not allow a spin-in fitting with 1-inch (25-mm) flange, provide a side take off fitting with integral transition from reduced height rectangular duct to round duct.

C. Materials: 22 gauge thickness, galvanized, stainless steel or aluminum to match duct system material.

D. Volume Damper: Integral with locking quadrant, 3/8" aluminum square shaft, nylon bushing and 2-inch (50-mm) build out for insulation thickness.

E. Options:

1. Insulation guard.
2. All seams sealed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Where rectangular manual volume dampers are indicated on the Contract Drawings with a height 10-inches (250-mm) and larger, provide multiple blade volume dampers.

F. Where round manual volume dampers are indicated on the Contract Drawings, provide manufactured manual volume dampers.

G. Set dampers to fully open position before testing, adjusting, and balancing.

H. Install test holes at fan inlets and outlets and elsewhere as indicated.

I. Install fire dampers according to UL listing.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. Upstream of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
7. Control devices requiring inspection.
8. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Where ductwork systems are fire rated or grease containing exhaust, utilize Duct Access Panel Assemblies.

M. Access Door Sizes:

1. For ductwork smaller than 16-inches high: 12- by 12-inches (300 by 300 mm).
2. For ductwork smaller than 24-inches high but larger than 18-inches: 16- by 20-inches (400- by 500-mm)
3. For ductwork larger than 24-inches high: 24- by 24-inches (600- by 600-mm)

N. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

O. Install flexible connectors to connect ducts to any motor driven equipment.

P. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

Q. Where indicated on Contract Drawings, connect diffusers to duct mains with take off fitting with integral volume damper and flexible ductwork. Flexible ductwork shall be no longer than length indicated on detail on the Contract Drawings. Extend flexible duct insulation and vapor barrier over completed joint and tape securely.

R. Install duct test holes where required for testing and balancing purposes.

S. Protect open ends of ductwork and air duct accessories during construction, either stored or installed, with plastic covering.

3.2 FIRE DAMPER APPLICATION

A. For fire dampers installed behind grilles provide A-Style fire dampers which have the blades and frame in the airstream.

B. For fire dampers installed in low pressure ductwork systems provide B-Style fire dampers which have the blades out of the airstream but frame in the airstream.

C. For fire dampers installed in medium and high pressure ductwork systems provide C-Style fire dampers which have the blades and frames out of the airstream.

D. For fire dampers where the rated assembly will not allow the blades and frame to be out of the airstream, provide out of the wall style to sit adjacent to the rated assembly but allow the blades and frame to remain out of the airstream.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 34 10 **–** FANS AND GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work of this Section shall consist of the labor, materials and equipment required for installation of fans and gravity ventilators.

1.2 RELATED SECTIONS

A. Section 23 05 05, HVAC Basic Materials: Motors

B. Section 23 05 35, HVAC Sound and Vibration Control: Vibration isolators and bases.

1.3 SUBMITTALS

A. Submit for approval in accordance with specified submittal procedures:

1. Fans
2. B. Product Data: Submit manufacturer's technical product data for fans, including:
3. Selection characteristics and rated capacities.
4. Fan performance curves with system operating conditions indicated.
5. Sound power ratings, with an 8 octave band analysis for large, central system fans.
6. General specifications: Fan type description, material of construction, thicknesses and finishes.
7. Motor type, ratings and electrical characteristics
8. Accessories furnished

B. Shop Drawings: Include the following:

1. Plans, elevations, sections, and attachment details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to fan units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Coordination Drawings: As required to meet project complexity, show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

E. Maintenance Data: Submit operation and maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

F. Field quality-control reports.

G. Manufacturer's published fan curve data shall be included with shop drawing submittal data for fans. Fan curve information shall include operating point, RPM curve for operating point, minimum and maximum RPM curves for fan, system curve and brake horsepower curves. Tabular fan performance charts are not an acceptable substitute for fan curve data. Shop drawing submittals for air handling equipment will be returned without Architect's review if the fan curve data is not included with the submittal.

1.4 QUALITY ASSURANCE

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

B. Fan rating shall be AMCA certified.

1.5 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

1.6 EXTRA MATERIALS

A. Furnish one set of extra fan belt(s) for each fan. Identify unit designation on packaging sleeves.

PART 2 - PRODUCTS

2.1 GENERAL

A. Fan ratings shall be AMCA certified and statically and dynamically balanced and run tested at the factory.

B. Bearings: Fans, except power roof ventilators, shall be provided with lubricating type bearings with extended fittings as required. Extend grease fittings to safe, accessible locations.

C. Motors: Refer to Section 23 05 05 for motor requirements.

D. Accessories:

1. Belt guards: Where required, guards shall be fabricated to comply with OSHA and SMACNA requirements, constructed of expanded metal mesh to allow for quick visual inspection of belts and pulleys without removal. Guards shall be attached to equipment with hinges and/or quick release fasteners that can be turned without tools to allow for ease of maintenance. Secure to fan or fan supports without short circuiting vibration isolation.
2. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
3. Roof Exhaust Fan Roof Curbs: Provide manufacturers roof curb with outer finish to match fan. Provide hinging kit to allow easy access to damper. Curb shall be insulated with 2 inch thick sound and thermal insulation.

2.2 CABINET INLINE FAN, TYPE CFD

A. Acceptable Manufacturer: Greenheck Fan Corp., or Loren Cook Company, Broan, Carnes, PennBarry, Solar & Palau.

B. Blower: Backward inclined centrifugal, aluminum wheel, direct drive.

C. Housing

1. Galvanized steel with integral duct flanges.
2. Integral terminal box.
3. Access panels.
4. Removable fan motor and wheel assembly from housing.

D. Accessories

1. Electronic speed Controller.
2. Gravity Backdraft damper
3. Integral disconnect switch.
4. Duct inlet connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans and gravity ventilators in accordance with equipment manufacturer's recommendations. Submit manufacturer's printed installation instructions with operating and maintenance data at completion of Work.

B. Install fans level and plumb to prohibit excessive vibration and insure longer life.

C. Protect belts, sheaves, bearings, motors and other fan parts during installation.

D. Access: Provide adequate access and service clearance space around and over fans as indicated, but in no case less than that recommended by manufacturer. Allow adequate and safe pathway for components and unit replacement.

E. Isolation: Comply with requirements for vibration isolation devices specified in Section 23 05 35 .

F. Duct Connections:

1. Minimize Fan System Effects: Avoid poor fan inlet and outlet conditions. Comply with manufacturer's installation guidelines.
2. Make final duct connections with flexible connectors.
3. Install ducts adjacent to fans to allow service and maintenance.
4. Provide access door in duct below power roof ventilators to service damper.

G. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

H. Electrical Connections: Ground equipment and connect control wiring according to Division 26.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of fans, and after motor has been energized with normal power source, perform the following tests and inspections with the assistance of a factory-authorized service representative to demonstrate compliance with requirements:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, make final alignments of pulleys and belt tension, and install belt guards.
5. Adjust damper linkages for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire dampers in connected ductwork systems are in fully open position.
8. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
9. Prepare test and inspection reports.

B. Remove and replace malfunctioning units that cannot be satisfactorily corrected and retest as specified above.

END OF SECTION

SECTION 23 37 13.23 - AIR REGISTERS AND GRILLES

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. Registers

B. Related Requirements:

1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 23 37 13.13 "Air Diffusers" for various types of air diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For the following products:

1. Registers

B. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

C. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

D. Color Selection Chart: For each register and grille type, provide factory and custom options for color and finish for selection.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Adjustable Blade Face Register, Type SR - Supply Register:

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

    a. Krueger
    b. Price Industries.
    c. Titus (Basis of Design Model 300FL).

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade.

B. Fixed Face Register, Type RR - Return Register and Type ER - Exhaust Register:

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

    a. Anemostat Products; a Mestek company.
    b. Krueger
    c. Price Industries.
    d. Titus (Basis of Design Model 350FL).

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Frame: 1-1/4 inches wide.
6. Mounting: Countersunk screw.
7. Damper Type: Adjustable opposed blade.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 72 10 **–** ENERGY RECOVERY

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work of this Section shall consist of the labor, materials and equipment required for installation of energy recovery equipment.

1.2 RELATED SECTIONS

A. Section 23 00 50, HVAC Basic Materials.

B. Section 23 05 48.13, Vibration Controls for HVAC.

C. Section 23 05 13, Common Motors Requirements for HVAC Equipment.

D. Section 23 09 10, Building Automation System.

E. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.3 SUBMITTALS

A. Submit for approval in accordance with specified submittal procedures:

1. Packaged Energy Recovery Ventilators

B. Manufacturer's published fan curve data shall be included with submittal data for energy recovery units. Fan curve information shall include operating point, RPM curve for operating point, minimum and maximum RPM curves for fan, system curve and brake horsepower curves. Tabular fan performance charts are not an acceptable substitute for fan curve data. Submittals for energy recovery equipment will be returned without Engineer's review if the fan curve data is not included with the submittal.

1.4 QUALITY ASSURANCE

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

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. Fan ratings shall be AMCA certified.

1.5 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. Filters: One set for each air-handling unit.
2. Fan Belts: One set for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY VENTILATOR, TYPE ERV

A. Acceptable Manufacturer: Greenheck Fan Corp.(Basis of Design, Model ERV-20-15L) , or AAON, Ruskin, Munters.

B. General:

1. Listing: ANSI/UL 1995, Heating and Cooling Equipment.
2. Energy Transfer Ratings, Energy Recovery Wheel: ARI Certified.
3. Ventilators Certification: AMCA Certified Rating Seals for Air Performance.

C. Cabinet:

1. Material: Galvanized Steel.
2. Insulation: Manufacturer’s standard internal insulation, complying with ASHRAE 62.1.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Mounting: Manufacturer-designed provisions for field installation.
5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

D. Energy Recovery Wheel:

1. Type: Enthalpy for both sensible and latent heat; designed to insure laminar flow. Energy recovery device shall transfer moisture entirely in the vapor phase.
2. Energy Transfer Ratings: ARI Certified to Standard 1060 and bear the ARI certification symbol for ARI Air-to Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060. Ratings “in accordance with 1060” without certification will not acceptable.
3. Desiccant: Silica gel with polymer media mounted in a stainless steel rotor for corrosion resistance. Wheels with sprayed on desiccant coatings or with desiccant applied after wheel formation will not be acceptable.
4. Wheel Design: Removable segments (for wheels greater than 26 inches in diameter) with silica gel desiccant permanently bonded to wheel media to retain latent heat recovery after cleaning.
5. Drive Belt: High strength urethane, factory installed in a pre-stretched state, eliminating the need for field belt tension adjustment. Link style belts will not be acceptable.
6. Frost Control: Factory programmed speed controller controlled by outdoor air temperature sensor and wheel pressure drop sensor to modulate wheel speed for frost control mode. Both sensors shall be satisfied to employ frost control.
7. Warranty: 5 years.

E. Fans:

1. Type: Centrifugal, double width, double inlet, single fan forward curved type.
2. Wheels: Statically and dynamically balanced.
3. Shafts and Bearings: Ground and polished steel shafts mounted in lubricated, sealed ball bearing pillow blocks with lubrication fittings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at a maximum cataloged operating speeds.
4. Separate motors for exhaust shall allow independent balancing of exhaust and supply airflows.
5. Speed controllers on direct-drive fans shall allow independent balancing of exhaust and supply airflows. Fan and motor assemblies shall be mounted to unit base with neoprene isolators.
6. Fans shall be located in draw-through position in reference to the energy recovery wheel.

F. Motors:

1. Type: Permanently lubricated, heavy duty type, matched to the fan. Refer to Section 23 05 05.
2. Mounting: Belt-drive motors factory mounted to an adjustable motor plate having two heavy-duty adjusting bolts for alignment and belt tension.
3. Drives: Sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast type, keyed and securely attached to the fan wheel and motor shafts; 10 horsepower and less shall be supplied with an adjustable drive pulley.

G. Filters:

1. Supply and Exhaust Air Filters: 2-inch thick pleated fiberglass, minimum MERV 8 (30-35% efficient) and tested to meet UL Class 2.
2. Filter Racks: Die-formed galvanized steel.

H. Dampers:

1. Insulated, low leakage type, opposed blade.
2. Installed on outside air intake and exhaust discharge.

I. Electrical:

1. All internal electrical components shall be factory wired for single point power connection.
2. All electrical components shall be UL Listed, Approved or Classified where applicable and wired in compliance with the National Electrical Code.
3. Factory mounted fused disconnect switch for power to units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install energy recovery equipment in accordance with equipment manufacturer's recommendations. Submit manufacturer's printed installation instructions with operating and maintenance data at completion of Work.

B. Install units level to prohibit excessive vibration and insure longer life.

C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fans have been test run under observation. Replace temporary filters used during construction with new, clean filters prior to start of air system testing and balancing.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of units, and after motor has been energized with normal power source, perform the following tests and inspections with the assistance of a factory-authorized service representative to demonstrate compliance with requirements:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, make final alignments of pulleys and belt tension, and install belt guards.
5. Adjust damper linkages for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

B. See Section 23 05 93 for testing, adjusting, and balancing procedures.

1. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.

C. Remove and replace malfunctioning units that cannot be satisfactorily corrected and retest as specified above.

END OF SECTION

SECTION 23 82 10 **–** TERMINAL HEATING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work of this Section shall consist of the labor, materials and equipment required for installation of terminal heating units.

1.2 SUBMITTALS

A. Submit for approval in accordance with specified submittal procedures:

1. Duct Coils
2. Horizontal Unit Heaters

PART 2 - PRODUCTS

2.1 DUCT COIL, ELECTRIC

A. Acceptable Manufacturer: Brasch Manufacturing Company Inc., or Indeeco, Redd-I Inc.

B. Heating Elements

1. Material: 80 percent nickel, 20 percent chromium resistance coils.
2. Terminals: Stainless steel, insulated by ceramic bushings.
3. Miscellaneous: Step control to be arranged to prevent stratification when operating at partial capacity.
4. Frame: Slip in construction of heavy gage galvanized or aluminized steel having vertical steel supports with stiffening ribs and gussets spaced no more than 4 inches apart, spot welded to frame.
5. Terminal Box: Recessed, to assure elements and safety controls are in airstream. Solid box cover, to minimize dust infiltration. Insulated, to minimize condensation.
6. Element Safety Devices: Primary over temperature protection shall be disc type automatic reset thermal cutout. Secondary protection shall incorporate a sufficient number of heat limiters in the power lines to deenergize elements if primary cutout fails. Built-in pressure type air flow switch to interlock fan and heating element.

C. Remote Control Panel

1. Regulations: UL listed, shall meet NEMA 1 and applicable NEC requirements.
2. Ventilation: Panel to be provided with convection cooling without allowing molten material to escape in case of fault.
3. Controls, factory wired complete with:

a. Main interlocking disconnect switch.
b. Transformer with secondary fuses per NEC.
c. SCR with operating contactors and branch circuit fuses for each step.
d. Safety contactors.

D. Miscellaneous: Submit detailed wiring diagrams showing internal connections of panel and heater, power supply connections and connections between panel and heater. Typical printed product data wiring diagrams will not be an acceptable submittal.

E. Controls: Refer to Section 23 09 10 - Building Automation System.

2.2 HORIZONTAL UNIT HEATER, ELECTRIC

A. Acceptable Manufacturer: Trane, or QMark, Berko.

B. Casing: Heavy gage steel with baked enamel finish. Top plate shall be provided with threaded or drilled hanger connections.

C. Heating Element: Individually replaceable steel sheathed type with built-in automatic reset high limit switch.

D. Motors: Continuous duty, direct connected to fan. Provide built in automatic reset thermal overload protection.

E. Fan: Aluminum or steel blades, statically and dynamically balanced.

F. Outlet: Adjustable discharge louverr.

G. Controls: Low voltage thermostat with heat-off fan settings. Thermostat shall cycle fan. Thermostat shall be remote mounted. Integral safety disconnect switch.

H. Fan Guard: Removable heavy duty wire cage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install terminal heating units in accordance with unit manufacturer's recommendations. Submit manufacturer's printed installation instructions with operating and maintenance data at completion of Work.

B. Filters installed in cabinet unit heaters during the construction period will be considered temporary. Provide new throwaway type unit filters at time of Owner acceptance of Work.

END OF SECTION

SECTION 23 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

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

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

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

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg. Select ratings below based on application.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg. Select ratings below based on application.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg. Select ratings below based on application.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

B. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

C. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

D. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

E. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

F. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

G. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Firestopping method for all penetrations containing low-voltage and control cabling shall allow for easy addition or replacement of cabling in future. Sealing sleeves or openings with single-use sealant is not acceptable.

3.4 IDENTIFICATION

A. Identification of penetrations is in addition to building code requirements for identification of fire and smoke barriers.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following minimum information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb" or similar.
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency, or permit agency.
4. Inspection/Permit number.
5. Date of installation.
6. Manufacturer's name.
7. Manufacturer's product.
8. Product UL or ASTM Listing.

3.5 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM APPROVAL

1. Provide UL-classified systems. Refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

END OF SECTION

SECTION 26 00 00 - GENERAL PROVISIONS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

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. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. 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.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 SUBMITTALS

A. Comply with Division 01 requirements for submittals.

B. Submit shop drawings and product data for approval to Architect.

C. Action Submittals 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.

D. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include 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.

1. Architect will not review submittals received from Contractor that do not have stamp indicating Contractor's review and approval.

E. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return to Contractor.

F. Informational Submittals: Architect 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.

G. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

H. Each submittal shall contain shop drawings or product data for items in only one specification section. Submittals containing information about items from multiple specification sections will be returned without review.

I. Each submittal shall contain shop drawings or product data for all items in one specification section to be provided for this Project. Incomplete submittals are unacceptable and will be returned for resubmittal without review.

J. Architect will return without review submittals received from sources other than Contractor.

K. Submittals not required by the Contract Documents will be returned by Architect without review or action.

L. Clearly identify on each submittal specified items, accessories, and options, as applicable to this project. Catalog numbers, part numbers, etc. on submittals will not be reviewed for correctness. Submittals not clearly indicating only the items to be provided for this project will not be approved.

M. Submittal review by Architect is for conformance with design concept of the Project and general compliance with information given in the construction documents. Approval, corrections and/or comments made as part of the submittal review do not relieve the Contractor of the responsibility from conformance with all requirements of the Contract Documents, applicable codes and laws. Contractor is responsible for dimensions, quantities, and performance requirements to be confirmed and correlated at the job site; for information that pertains solely to the fabrication processes or to techniques of construction; and for all coordination with the Work of all trades.

N. At the time of each submittal, Contractor shall give Architect specific written notice of such variations, if any, that the Shop Drawing or product submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and sample submitted to Architect for review and approval of each such variation.

O. Architect's review and approval of Shop Drawings or products shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called the Architect's attention to each such variation at the time of each submittal and Architect has given written notation thereof incorporated in or accompanying the Shop Drawing or product approval; nor will any approval by Architect relieve contractor from responsibility for complying with the requirements of this paragraph.

P. Shop drawing submittals shall be accompanied by a transmittal sheet with the applicable specification section number and the "name" of the item or items being submitted clearly indicated on the transmittal. All "names" on the transmittal shall match exactly the "names" listed in the specifications for the item being submitted.

Q. The name of the supplier, distributor, subcontractor, etc., who will furnish equipment and items to the Contractor shall appear on the shop drawings when submitted. Shop drawing submittals without supplier's, distributor's, subcontractor's, etc., name will be returned without being reviewed.

R. If Architect is required to review any shop drawing or product data submittal more than two times, a Change Order will be issued to the Contractor for a credit due on the Contract Price to recoup Architect's expenses associated with the multiple reviews.

S. Complete sets of approved shop drawings and product data, as required in Division 01, shall be delivered to Owner at completion of Work.

1.4 SUBSTITUTIONS

A. Comply with Division 01 requirements for substitutions.

B. Specifications for each piece of equipment and each item of material are written around a product of a specific base manufacturer. This base manufacturer is the basis of design, dimensions, and details. The basis of design manufacturer's name and model information are included with the product description as designated next to the manufacturer's name under the heading "Acceptable Manufacturers".

C. Substitution • manufacturers are defined as any manufacturer other than the one used as the basis of design. Substitution • manufacturers will be permitted, in accordance with the bidding requirements and where indicated herein.

D. Manufacturers named in the product description, in addition to the base manufacturer, are substitution manufacturers, have been determined to be manufacturers capable of manufacturing products similar to the base manufacturer and these manufacturers are acceptable substitution manufacturers to the base manufacturer. Where additional manufacturer’s names do not appear with the base manufacturer, the Architect reserves the right to disallow any substitution manufacturers. Where the base manufacturer’’s name is followed by the term “no substitution”, no substitution manufacturers will be considered.

E. Naming of specific manufacturers shall not be construed as eliminating products or services of other substitution manufacturers having comparable items. Where permitted by these Specifications, and where Bidder desires to use other substitution manufacturers, they may submit a request for approval to use the substitution manufacturer in accordance with bidding requirements.

F. Products described in Specifications are intended to set a quality level and ensure a workable system. Substitution of manufacturers, including those herein named, may be made only after approval of Architect. Bidder shall assume full responsibility for installation and dimensional changes required by the use of all substitution manufacturer's products, including revisions to wiring, controls, piping, structural revisions, etc., and all room or space changes as required due to dimension differences of the substitution manufacturer product. Architect approval of substitution manufacturer's products shall be limited to compliance with information given on the Drawings and Specifications.

G. Where the Bidding requirements call for submittal for approval of substitutions prior to bids due, all approvals given are for substitution manufacturers only, not approval of any particular product. An approved substitution manufacturer's product must comply with all requirements of the specifications and drawings for the base manufacturer's product.

1.5 PRODUCTS

A. MATERIALS

1. Provide all materials and equipment as new, without imperfections or blemishes.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Drawings are generally indicative of work to be installed but may not indicate all bends, fittings, boxes, etc. required to meet field conditions.

B. Coordinate installation of work of this Division with Work of other Divisions. Install in most direct manner possible to avoid interference between conduits, piping, ducts, equipment, and architectural or structural features. Work installed in an arbitrary manner without regard for Work of other Divisions will not be accepted.

C. Provide scaffolding and hoist or rigging materials as required for installation of Work of this Division.

D. Where equipment is furnished as Work of other Divisions for installation or wiring under Work of this Division, obtain and coordinate with approved shop drawings and installation instructions from respective contractor prior to rough-in.

E. Electrical scope shown in each area of work shall be completed during construction phase as indicated on architectural phasing plans and/or phasing construction sequence narrative.

F. Codes and Standards:
1. Comply with all applicable local, state, national, and international codes and ordinances.
2. Reference to codes and standards listed herein shall constitute minimum acceptable requirements. Where Drawings and Specifications requirements exceed those of codes listed, Drawings and Specifications shall take precedence for Work of this Project.
3. Where applicable, materials and equipment shall bear the label of approval of Underwriters Laboratories, Inc.
4. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

G. Coordination - New Construction:

1. Openings and recesses in new construction (including cutting, patching, and finishing) necessary for installation of Work of this Division to be provided by General Contractor. Coordinate required locations, dimensional data, and scheduling of Work with General Contractor.
2. Where conduit is run concealed in concrete masonry unit (block) walls, Contractor shall be responsible for installing his work in cores of block for mason to wall-in as he carries up wall. Coordinate locations and scheduling of Work with General Contractor.

H. Coordination - Existing Construction:

1. Cut openings required in existing construction for installation of electrical equipment, materials, and devices. Perform all cutting, patching, and refinishing as required to match surroundings.

I. Concrete:

1. Furnish and install concrete for Work of this Division. Concrete work shall be completed in accordance with requirements of Division 03.

J. Excavation and Backfill:

1. Perform excavation and backfill required for Work of this Division, inside and outside building. Excavation and backfill shall be in accordance with requirements set forth in Division 31.

   a. Include saw cutting, trenching, backfilling, patching of all areas disturbed by excavation.
   b. Banks and excavations shall be retained by means of shoring and braces to avoid cave-ins. Shoring shall be in accordance with the requirements of state and local regulatory agencies. Shoring shall be maintained until installation, tests, and inspections are complete.
   c. Pumping equipment shall be provided and maintained to pump water from excavations.

2. Comply with Pennsylvania Underground Utility Line Protection Law requirements before commencing any excavation work.

K. Painting:

1. Equipment furnished under this Division that is pre-painted or pre-finished by manufacturer shall have all nicks, scratches, blemishes, and rust spots cleaned, primed, and refinished prior to final acceptance by Owner.
2. Painting shall be in accordance with the Division 09.
3. General Contractor will paint exposed unfinished equipment, conduit, supports and miscellaneous steel installed under this Division.

L. Existing Equipment:

1. Removal of Existing Equipment: Electrical equipment and materials indicated on drawings as "to be removed" • • shall be removed as Work of this Division. Items of value as determined by Owner shall be stored on site where directed by Owner. Equipment and material that Owner does not wish to retain shall be legally disposed of offsite. Do not remove any equipment and materials from the site without Owner's approval.

2.2 HAZARDOUS MATERIALS

A. Promptly notify Owner and Architect if hazardous materials are observed in the structure or on the project site during the course of Work. Do not perform any work pertinent to the hazardous material prior to receipt of special instructions from the Owner. "Hazardous materials" • • are defined as asbestos, PCBs, petroleum, radioactive material, or hazardous waste substances.

2.3 CLEANING

A. Upon completion of Work, remove all dirt, foreign materials, stains, fingerprints, etc., from all parts and equipment.

B. Remove all construction debris and vacuum interior spaces of all compartmental equipment.

C. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

2.4 Work shall be subject to inspection by the PROTECTION FROM DUST AND DEBRIS

A. During patching, painting, ceiling removal and replacement, working on the ceiling or on things above the ceiling, etc., maintain cloths or suitable building paper covers to protect building surfaces. Protective measures (drop cloths, protective covers, etc.) shall be placed and sealed over all furniture and equipment to keep items clean and protected against dirt, dust and debris from entering furniture and equipment that the Owner has not removed.

B. Upon completion of work each day when building is occupied, remove all temporary covers, drop cloths, and debris and vacuum clean all worked-in areas to mitigate carrying of dirty materials and tracking dirt throughout building during time construction is not occurring.

2.5 ACCEPTANCE TESTING

A. Electrical Acceptance Testing

1. Testing shall be performed on electrical equipment and systems to assure that equipment and systems are operational and within applicable standards and manufacturer's tolerances. Testing should verify that equipment and systems are installed in accordance with design specifications. All testing shall occur at the building site.
2. Testing shall be performed by an independent organization that is professionally independent of the manufacturers, suppliers, and installers of the equipment or systems being evaluated. The name of the proposed testing organization shall be submitted to Engineering Services Electrical Group for approval.
3. Qualified technicians who are trained and regularly employed for testing services shall do all testing. Submit technician qualifications.
4. The testing organization shall conform to the general guidelines of section 5 of the latest NETA Acceptance Testing Specifications, in their entirety. This includes the following:

    a. Safety and Precautions
    b. Suitability of Test Equipment
    c. Test Instrument Calibration
    d. Test Report

5. Provide report in the Megger "Power DB• " program. Furnish one (1) original, editable electronic (.mdb format), one (1) electronic PDF copy, and Four (4) paper copies of the completed report to Engineering Services Electrical Group. Have the testing firm contact Engineering Services Electrical Group to procure PSU standard Power DB testing forms.
6. Notify Engineering Services Electrical Group at least seven (7) days in advance of any testing. A representative of Engineering Services Electrical Group shall witness testing.

7. Inspection and testing of all applicable electrical equipment listed below shall be done in accordance with the latest version of NETA ATS. This will include all tests marked optional unless waived in writing by Engineering Services Electrical Group.

    a. Transformers, Air Cooled
    b. Cables, Low Voltage
    c. Circuit Breakers, Low Voltage, Insulated Case/Molded Case (100 amp frame and larger)
    d. Instrument Transformers
    e. Metering
    f. Grounding Systems
    g. Ground Fault Protection Systems
    h. Motors: AC and DC
    i. Motor Starters: Low Voltage
    j. Adjustable Speed Drive Systems
    k. Direct Current Systems, Batteries
    l. Direct Current Systems, Battery Chargers

8. Testing organization shall perform adjustments for final protective device setting in accordance with coordination study (Power Study) provided by Contractor or owner; prior to performing any testing.

B. System Function Tests

1. Perform system function tests upon completion of equipment tests as defined in this specification. It is the purpose of the system function tests to prove the correct interaction of all sensing, process, and action devices.
2. Verify the correct operation of all safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of all sensing devices, alarms, and indicating devices.

C. Electromagnetic Field Testing

1. Determine the vector-valued quantity of magnetic flux density for power frequency magnetic fields over a predetermined space or area, as designated by Engineering Services Electrical Group.
2. Perform testing in accordance with the latest version of NETA ATS.

D. Voltage Drop Testing

1. Perform a voltage test at the last receptacle of each branch circuit of each Panelboard. Total voltage drop shall not exceed 3% of the initial voltage measured at the end of that branch circuit. Perform the test using a 12A load attached to the furthest receptacle. Correct any installation with a voltage drop of greater than 3%. If a branch circuit fails the test, perform the test on all other branch circuits on that panel.
2. Provide documentation of the results shall be provided to Engineering Services Electrical Group.

END OF SECTION 26 00 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Luminary cable.
4. Connectors, splices, and terminations.

B. Related Requirements:

1. Section 27 15 13 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

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

1. Alpha Wire Company.
2. Belden Inc.
3. Cerro Wire LLC.

4. General Cable Technologies Corporation.
5. Okonite Company (The).
6. Prysmian Group.
7. Southwire Company.
8. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type XHHW: Comply with UL 44.
2. Type XHHW-2: Comply with UL 44.

F. Aluminum conductors will not be permitted on this project.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

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

1. AFC Cable Systems; a part of Atkore International.
2. Alpha Wire Company.
3. Belden Inc.
4. General Cable Technologies Corporation.
5. Okonite Company (The).
6. Prysmian Group.
7. Southwire Company.
8. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type XHHW: Comply with UL 44.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Aluminum, interlocked.

2.3 LUMINARY CABLE

A. Description: A factory assembly of insulated current-carrying conductors, including two phase conductors, one equipment ground, and two low-voltage control conductors, in an overall metallic sheath.

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

1. AFC Cable Systems; a part of Atkore International.
2. Encore Wire Corporation.
3. Southwire Company.

C. Standards:

1. Underwriters Laboratories Standards: UL-66, UL-83, UL-1479, UL-1569, UL-1581, UL-2556.
2. Federal Specification A-A-59544.
3. ASTM-B3 and B8.
4. NFPA 70 Article 250.118(10)(a), 300.22(C)(1), 330, 392, 396, 501, 502, 503, 504, 505, 518, 520, 530, 645, 725.
5. ARRA 2009 Section 1605 "Buy American• " Compliant.
6. UL CRD Type MC-PCS - 12/19/2014 (Effective 2/1/2015).
7. L Listing #E-301130.

D. Circuits:

1. Single LED or Fluorescent dimmable lighting circuit.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation: Color-coded PVC compound meeting the required thickness of Type THHN/THWN-2 with a heat-stabilized Nylon rated for 90ºC for use in dry or wet locations.

H. Armor: Aluminum, interlocked.

2.4 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. 3M Electrical Products.
2. ABB (Electrification Products Division).
3. Atkore International (AFC Cable Systems).
4. Emerson Electric Co. (Automation Solutions - Appleton - O-Z/Gedney).
5. Gardner Bender.
6. Hubbell Incorporated (Hubbell Power Systems).
7. Ideal Industries, Inc.
8. ILSCO.
9. NSi Industries LLC.
10. Service Wire Co.
11. TE Connectivity Ltd.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Listed for use with applicable conductor types.
2. Type: One or two hole as required, standard barrels.
3. Termination: Compression or crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Lighting Circuits: Copper. Solid for phase and ground conductors; stranded for control conductors.

D. ASD Output Circuits Cable: Extra-flexible stranded for all sizes #8 or larger.

E. Minimum Wire Size, All Power and Lighting Applications: No. 12 AWG.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exterior:

1. Service Entrance: Type XHHW-2, single conductors in raceway.
2. Feeders: Type XHHW-2, single conductors in raceway.
3. Branch Circuits: Type XHHW-2, single conductors in raceway.

B. Interior:

1. Feeders: Type XHHW, single conductors in raceway.
2. Branch Circuits: Type XHHW, single conductors in raceway, unless noted otherwise.

a. All conductors No. 8 AWG and larger shall be Type XHHW-2.

C. Lighting Circuits, LED and Fluorescent Dimmable: Luminary cable.

1. Luminary cable may be fished in the voids of existing masonry walls for wiring to luminaires or devices in lieu of cutting, patching and refinishing.

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

E. Metal-clad Cable, Type MC may be used in the following applications:

1. In rooms in lieu of conduit and wire for branch circuits No. 10 AWG and smaller from the first junction box or outlet box after the branch circuit home run wiring enters the room.

a. Install conduit and wire for branch circuit homerun wiring from the panelboard to the first junction or outlet box within the room, as well as between rooms on the same circuit. The first junction box or outlet box shall be located within the room where the utilization equipment and wiring devices, etc., are located.
2. Fished in the voids of existing masonry walls for wiring to wiring devices in lieu of cutting, patching and refinishing.
3. Final connection to lighting fixtures in lengths not exceeding 6 feet. Do not wire directly from fixture to fixture, each recessed light fixture shall be wired from a junction box.
4. Final connection to chain hung industrial-style fixtures in mechanical, electrical, and unfinished support spaces.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. General Installation

1. Install conductor and cable types only where specifically permitted for use by NFPA 70.
2. Provide separate neutral conductor for every interior branch circuit. Shared neutral conductors will not be permitted.
3. Install conductors continuous between outlets without splicing except in approved junction boxes.
4. Conceal cables in raceway within finished walls, ceilings, and floors unless otherwise indicated.

5. All conductors shall be installed in raceways unless noted otherwise. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
6. Exact location, material, and thickness of all walls to be chased or cut for installation of wiring shall be verified with Architect and General Contractor before commencing work.
7. Install detectable warning tape above all underground cable, 12 inches below finished grade.
8. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
9. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
10. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
11. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
12. Inspect exposed sections of existing cable and conductors for physical damage, condition of insulation or jacket, compression connectors with proper cable match and indentation, and correct identification.

B. Metal-clad Cable, Type MC

1. Install only where explicitly permitted by NFPA 70.
2. Do not install exposed, in areas without ceilings, or in new masonry walls.
3. MC cable may be run concealed above ceilings or where concealed in wood or metal stud walls or where concealed in furred out walls.
4. Installation of MC cable shall meet latest NEC and NECA 120 installation requirements.

C. Luminary Cable

1. Install only where explicitly permitted by NFPA 70.
2. Do not install exposed, in areas without ceilings, or in new masonry walls.
3. Luminary cable may be run concealed above ceilings or where concealed in wood or metal stud walls or where concealed in furred out walls.
4. Installation of Luminary Cable shall meet latest NEC and NECA 120 installation requirements.
5. When furnished with a PVC jacket, Luminary Cable may be surface mounted, fished, or embedded in plaster in wet, damp, or dry locations, interior or exterior. PVC-jacketed Luminary Cable may also be installed in corrosive conditions, directly buried in earth, or embedded in concrete.

D. ASD Output Circuits

1. Type TC-ER cable shall be used for all ASD-controlled motors rated at or above 10Hp, 480 V or 208 V, three phase.
2. Provide standard branch circuit conductors from the equipment disconnect switch to the ASD and make final connections.
3. Provide ASD cabling from the ASD to the motor and make final connections.
4. Provide all cabling with approved termination fittings.

3.4 CONNECTIONS

A. Splice connectors, No. 8 AWG and smaller: Wing-nut, compression solderless connector.

B. Splice connectors, No. 6 AWG and larger: Split bolt pressure connector or compression connector, short-sleeve.

C. Lug connectors, connection to motor leads: Compression or crimp connector, standard or short-sleeve.

D. Lug connectors, stranded wire under binding screw or bolt: Compression or crimp connector, standard or short-sleeve.

E. Lug connectors, connection to bus or terminal: Compression or crimp connector, standard or short-sleeve, or bolted pressure connector.

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

G. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

H. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

I. Fasten lugs on motor leads with brass machine bolds, lock washers, and nuts.

J. Do not terminate stranded wire under a binding screw or bolt unless connector is explicitly listed for use with stranded wire.

K. Tighten all screws and terminal bolts using torque wrench to manufacturer or code required tightness.

L. Cap all spare conductors with UL listed end caps.

M. Terminate only one conductor per terminal or lug unless connector is listed for use with more than one conductor.

N. All connections made below grade shall be made with UL listed waterproof connectors.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 26 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.
    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. Section includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.

B. Related Requirements:

1. Section 27 05 28 "Pathways for Communications Systems" specifies additional requirements for grounding and bonding of communications raceways, boxes, and cable trays.
2. Section 27 11 00 "Communications Equipment Room Fittings" specifies additional requirements for grounding and bonding of communications equipment.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

1) Ground rods.
2) Grounding busbars.

b. Instructions for periodic testing and inspection of grounding features at the following locations, based on NETA MTS requirements:

1) Grounding busbars.
2) Grounding connections for separately derived systems.

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

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

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

1. Advanced Lightning Technology, Ltd.
2. Burndy; Part of Hubbell Electrical Systems.
3. Dossert; AFL Telecommunications LLC.
4. ERICO International Corporation.
5. Fushi Copperweld Inc.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Siemens Industry, Inc., Energy Management Division.
10. Thomas & Betts Corporation; A Member of the ABB Group.

2.2 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:

a. Soft or Annealed Copper Wire: ASTM B3
b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.3 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 27 05 26 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:

1. General Characteristics:

a. Two pieces with zinc-plated bolts.
b. Clamp Material: Silicon bronze.
c. Listed for outdoor use.

E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:

1. General Characteristics:

a. Clamp Material: Brass.
b. Listed for outdoor use.

F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp:

1. General Characteristics:

a. Clamp Material: Aluminum.
b. Listed for outdoor use.

G. UL KDER - Beam Grounding and Bonding Clamp;

1. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

H. UL KDER - Exothermically Welded Connection:

1. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Bonding Bushing:

1. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing:

1. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.5 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Grounding and Bonding Hub:

1. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.6 GROUNDING AND BONDING CONNECTORS

A. Source Limitations: Obtain products from single manufacturer.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:

1. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:

1. General Characteristics: Mechanical-type, aluminum or copper rated for direct burial terminal with set screw.

E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:

1. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch centers for two-bolt connection to busbar.

F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:

1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:

1. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.

    a. Copper or copper alloy, C and H shaped.

H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:

1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.

    a. Copper or copper alloy.

2.7 INTERSYSTEM BONDING BRIDGE GROUNDING CONNECTORS

A. Description: Devices that provide means for connecting communications systems grounding and bonding conductors at service equipment or at disconnecting means for buildings or structures.

B. Performance Criteria:

1. Regulatory Requirements:

    a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:

    a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDSH - One-Piece Intersystem Bonding Bridge Grounding Connector:

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:

    a. Galvan Industries, Inc.; Electrical Products Division, LLC.
    b. Madison Electric Products; business of Southwire Company, LLC.
2. General Characteristics: Zinc-alloy one-piece construction; six terminating points; gangable.

D. UL KDSH - Two-Piece Intersystem Bonding Bridge Grounding Connector:

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:

    a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Zinc-alloy body and polycarbonate cover; four terminating points.

2.8 GROUNDING AND BONDING BUSBARS

A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Rack and Cabinet Bonding Busbar:

1. General Characteristics:

a. Bus: Rectangular bar of hard-drawn solid copper.
b. Horizontal Mounting Dimensions: Designed for mounting in 19 inch wide equipment racks or cabinets. Coordinate with University furnished cabinets before ordering materials.
c. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
d. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

2.9 GROUNDING (EARTHING) ELECTRODES

A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Rod Electrode:

1. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

A. Grounding and Bonding Conductors:

1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
6. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum.

B. Grounding and Bonding Connectors:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.
4. Connections between the service entrance equipment and the CGEB: Exothermically welded connectors at the external grounding bus.
5. Connections to Telecom Ground Bus(es): Exothermically welded connectors on both ends.
6. Connections to Water Service, Gas Service, Ground Rods, and Building Steel: Bolted connectors at the external grounding bus.
7. Transformer(s) within the main electrical room: Bolted connectors at the external grounding bus.

C. Grounding and Bonding Busbars: Provide in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on Drawings.

3.3 SELECTION OF GROUNDING AND BONDING PRODUCTS FOR COMMUNICATIONS

A. Comply with Section 27 05 28 "Pathways for Communications Systems" and Section 27 11 00 "Communications Equipment Room Fittings."

3.4 INSTALLATION OF GROUNDING AND BONDING

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Grounding and Bonding Conductors:

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

1) Bury at least 30 inch below grade.
2) Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.

2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

g. Grounding and Bonding for Piping:

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

h. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft apart.

3. Neutral Conductors: Maintain continuity throughout the system and ground only at the service neutral.
4. Grounding and Bonding Busbars:

a. Install busbar horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
b. Where busbars are indicated on both sides of doorways, route bonding conductor up to top of door frame, across top of doorway, and down; connect to continuation of horizontal busbar.
c. Install external grounding bus on wall adjacent to the service entrance equipment. Install external grounding bus on wall adjacent to distribution equipment in rooms other than the service entrance.
d. Install bare copper cable (minimum 2/0 AWG) from external grounding bus to ground rod electrode and terminate with exothermic weld connection. Install bare copper cable (minimum 2/0 AWG) from GEB to external grounding bus and terminate with exothermic weld connections on both ends.
e. Identify each connection to the grounding busbar with an engraved nameplate.
f. Make exothermic-weld connections at the ground bus for the following grounding conductors:

1) Service entrance equipment ground bar.
2) Ground grid or ring.
3) Telecommunications Bonding Conductor (TBC).

g. Make bolt-on connections at the ground bus for the following grounding conductors:

1) Building steel.
2) Water service.
3) Natural gas or propane service.
4) Step-down transformer within the main electrical room.

5. Electrodes:

a. Ground Rods: Drive rods until tops are 18 inches below finished floor or final grade unless otherwise indicated.

1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2) Use exothermic welds for below-grade connections.

b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.

6. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.
b. Bond the system neutral to service entrance equipment enclosures.
c. Do not run ground conductors from service transformer to service entrance equipment.

7. Grounding Separately Derived Systems:

a. Ground each separately derived system neutral to the main building ground system unless otherwise indicated.

8. Grounding Underground Distribution System Components:

a. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
b. Comply with IEEE C2 grounding requirements.
c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 2/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.

9. Equipment Grounding and Bonding:

a. Install insulated equipment grounding conductors with feeders and branch circuits.

3.5 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

A. Field tests and inspections must be witnessed by Owner.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.

3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
    c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

C. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

D. Collect, assemble, and submit test and inspection reports.

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

    a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
    b. Manhole or Handhole Grounds: 10 ohms.

3.6 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes support systems, mounting hardware, anchoring, and attachment components and assemblies.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel, unless otherwise indicated.
3. Channel Width: Selected for applicable load criteria.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
7. Channel Dimensions: Selected for applicable load criteria.

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

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.

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

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101

B. Comply with requirements in Section 26 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

3.2 SUPPORT INSTALLATION

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

3.3 CONCRETE BASES AND HOUSEKEEPING PADS

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

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.

3.4 PAINTING

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

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

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

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metallic and non-metallic raceways.
2. Fittings for conduit, tubing, and cable.
3. Surface nonmetallic raceways.
4. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks and underground utility construction.
2. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Surface nonmetallic raceways.
2. Cabinets, cutout boxes, and miscellaneous enclosures.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

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

1. Allied Tube & Conduit; a part of Atkore International.
2. Champion Fiberglass, Inc.
3. Cooper Crouse-Hinds.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Patriot Aluminum Products, LLC.
6. RACO, by Hubbell.
7. Southwire Company.
8. Thomas & Betts Corporation; A Member of the ABB Group.
9. Western Tube and Conduit Corporation.
10. Wheatland Tube Company.

2.2 TYPE EMT-S RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Material: Steel.
2. Options:

a. Exterior Coating: Zinc.
b. Interior Coating: Zinc with organic top coating.
c. Colors: As indicated on Drawings.

2.3 TYPE EPEC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651A and UL Category Control Number EAZX.

B. Schedule 40 Electrical HDPE Underground Conduit (EPEC-40):

1. Dimensional Specifications: Schedule 40.

2.4 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Exterior Coating: Zinc.
2. Interior Coating: Zinc with organic top coating.

2.5 TYPE FMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1 and UL Category Control Number DXUZ.

B. Steel Flexible Metal Conduit (FMC-S):

1. Material: Steel.

2.6 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Material: Steel.

2.7 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Options:

C. Type EB Rigid PVC Concrete-Encased Underground Conduit (PVC-EB) and Fittings:

1. Dimensional Specifications: Type EB.
2. Options:

a. Minimum Trade Size: Metric designator 103 (trade size 4).

2.8 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listed and labeled for type of conduit, location, and use.
3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.

C. Fittings for Type EMT Raceways:

1. General Characteristics: UL 514B and UL Category Control Number FKAV.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Insulated throat for box connectors.

D. Fittings for Type FMC Raceways:

1. General Characteristics: UL514B and UL Category Control Number 1LNR.
2. Options:

a. Type: Steel or malleable iron.
b. Insulated throat for box connectors.

E. Fittings for Type LFMC Raceways:

1. General Characteristics: UL 514B and UL Category Control Number DXAS.
2. Options:

a. Insulated throat for box connectors.

F. Expansion and Deflection Fittings: Match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

G. Conduit Bodies

1. Malleable iron bodies finished with zinc or cadmium, inside and outside.
2. Screw-on type covers.

3. Neoprene gaskets and stainless steel screws where installed in damp or wet locations.
4. Size and type as required.

H. End Bells

1. Malleable iron, galvanized finish.

I. Conduit Seals

1. Malleable iron or copper-free aluminum.
2. Drain fittings where installed in vertical runs between different temperature zones.
3. Fiber filler and sealing cement.

J. Bushings

1. Malleable iron.
2. Insulated throat.
3. Ground lug, where required.

2.9 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 2419 and UL Category Control Number FOIZ.

2.10 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL Category Control Number DWTT.
3. Sustainability Characteristics:

2.11 SURFACE NONMETALLIC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

    a. UL 5A and UL Category Control Number RJTX.
    b. UL 94, V-0 requirements for self-extinguishing characteristics.

B. Surface Nonmetallic Raceways and Fittings with Nonmetallic Covers:

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

    a. Panduit Corp.
    b. Wiremold; Legrand North America, LLC. (Basis of Design)
    c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:

    a. Provide texture and color selected by Architect from manufacturer's standard colors.

3. Type: Large Capacity, Dual Channel Raceway, Wiremold 5400 Series.

    a. Dual channel. 5 1/4-inch by 1 3/4-inch cross section. 3.72 sq inch (2400 sq mm) cross sectional area per channel.
    b. Flush receptacles and data outlets, types and locations as shown on drawings.
    c. Furnish without devices where indicated.
    d. Furnish with required fittings, couplings, elbows, connectors, and devices.

2.12 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:

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

    a. ABB, Electrification Products Division.
    b. B-line; Eaton, Electrical Sector.
    c. Hoffman; nVent.
    d. MonoSystems, Inc.
    e. Square D; Schneider Electric USA.
    f. Wiegmann; Hubbell Incorporated, Commercial and Industrial.

2. Additional Characteristics:

    a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
    b. Finish: Manufacturer's standard enamel finish.

3. Options:

    a. Degree of Protection, Indoor: Type 1, unless otherwise indicated.
    b. Degree of Protection, Outdoor: Type 3R, unless otherwise indicated.
    c. Wireway Covers: Hinged type unless otherwise indicated.

2.13 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

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

1. ABB, Electrification Products Division.
2. Arlington Industries, Inc.
3. Crouse-Hinds; Eaton, Electrical Sector.
4. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
5. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
6. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
7. Pass & Seymour; Legrand North America, LLC.
8. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
9. Wiremold; Legrand North America, LLC.
10. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Comply with NEMA OS 1 and UL 514A.
3. Type: Recessed.
    a. Gangable, depth as required.
    b. Galvanized steel construction.
    c. Provide with plaster rings where installed in plaster finish areas.
    d. Provide with masonry rings where installed in masonry construction.
4. Type: Surface.
    a. Copper free aluminum or rust-resisting alloy construction.
    b. Threaded hubs compatible with applicable conduit.
    c. Gasketed, watertight covers, stainless steel screws for exterior applications.
    d. NEMA 4X, 316 stainless steel, neoprene gasketed, watertight covers, stainless steel screws where indicated.
    e. NEMA 7 for hazardous locations where indicated.

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

E. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

F. Gangable boxes are allowed.

G. Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
2. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

2.14 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

    a. Non-Environmental Characteristics: UL 50.
    b. Environmental Characteristics: UL 50E.
3. Sized as required based on application, unless otherwise indicated.

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

1. ABB, Electrification Products Division.
2. Arlington Industries, Inc.
3. Crouse-Hinds; Eaton, Electrical Sector.
4. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
5. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
6. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
7. Pass & Seymour; Legrand North America, LLC.
8. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
9. Wiremold; Legrand North America, LLC.
10. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Indoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Additional Characteristics: UL Category Control Number CYIV.

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

3. Degree of Protection: Type 1, unless noted otherwise.

D. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 1, unless noted otherwise.

E. Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 1, unless noted otherwise.

F. Indoor Sheet Metal Miscellaneous Enclosures:

1. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.
2. Degree of Protection: Type 1, unless noted otherwise.

G. Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 3R, unless noted otherwise.

H. Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 3R, unless noted otherwise.

I. Outdoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 3R, unless noted otherwise.

J. Outdoor Sheet Metal Miscellaneous Enclosures:

1. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.
2. Degree of Protection: Type 3R, unless noted otherwise.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed: ERMC .
2. Concealed Aboveground: ERMC .
3. Direct Buried: PVC-40 EPEC.
4. Concrete Encased in Trench: PVC-40 PVC-EB.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC..

C. Indoors:

1. Installed Beneath Concrete Slabs: PVC-40, ERMC .
2. Installed Within Concrete Slabs: EMT or PVC-40.
3. Exposed, Less Than Four Feet Above Finished Floor or Subject to Physical Damage: ERMC .
4. Exposed, Greater Than Four Feet Above Finished Floor and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Within existing furred concrete and concrete block walls: FMC.

    a. MC may be used in lieu of FMC for this application.

7. Damp or Wet Locations: ERMC .
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
9. Final Connection to Recessed Lighting Fixtures: FMC.

    a. MC or Luminary Cable may be used in lieu of FMC in lengths no longer than 6 feet for this application.

D. Minimum Raceway Size: 3/4-inch, unless otherwise indicated.

1. Minimum size for underfloor or underground applications: 1-inch.
2. Final connections to fixtures and equipment made with FMC or LFMC may be 1/2-inch.

E. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC : Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

    a. General: Type 3R unless otherwise indicated.
    b. Locations Exposed to Hosedown: Type 4.
    c. Locations in-Ground or Exposed to Corrosive Agents:Type 4X.

2. Indoors:

    a. General: Type 1 unless otherwise indicated.

C. Exposed Boxes Installed Less Than 4 feet Above Floor:

1. Provide cast-metal boxes or boxes without knockouts or unprotected openings.

2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
6. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
7. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
8. Raceway Terminations at Locations Subject to Moisture or Vibration:

    a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

b. Where an underground service raceway enters a building or structure.
c. Conduit extending from interior to exterior of building.
d. Conduit extending into pressurized duct and equipment.
e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
f. Where otherwise required by NFPA 70.

9. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
10. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
11. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
12. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
13. Do not install aluminum raceways or fittings in contact with concrete or earth.

C. Requirements for Installation of Specific Raceway Types:

1. Types ERMC :

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

2. Types FMC and LFMC:

a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

3. Type PVC:

a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
b. Comply with manufacturer's written instructions for solvent welding and fittings.
c. Do not install pull string until solvent or adhesive has fully dried.

4. Type EPEC:

a. Do not install Type EPEC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
b. Comply with manufacturer's written instructions for solvent welding and fittings.
c. Do not install pull string until solvent or adhesive has fully dried.

D. Raceways Embedded in Slabs:

1. Run raceways larger than metric designator 27 (trade size 1) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place raceway close to slab support. Secure raceways to reinforcement at maximum 10 ft intervals.
2. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
3. Arrange raceways to ensure that each is surrounded by a minimum of 1 inch of concrete without voids. Provide additional concrete cover where required by structural engineer to maintain integrity of slab.
4. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.

E. Stub-ups to Above Accessible Ceilings:

1. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

F. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC : Provide threaded type fittings unless otherwise indicated.
2. EMT: Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
4. Bushings: Provide bushings for all conduits trade size 1 1/2-in and greater.
5. Install expansion joints, conduit bodies, couplings, and hubs where required by application.

G. Expansion-Joint Fittings:

1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction appropriate for raceway type in accordance with NFPA 70 requirements.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.4 INSTALLATION OF SURFACE RACEWAYS

A. Install raceways concealed unless specifically noted otherwise. Install surface raceways only where indicated on Drawings or with approval of Owner.

B. Install surface raceway with a minimum 2 inch radius control at bend points.

C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

A. General Requirements for Installation of Boxes and Enclosures:

1. Install boxes in accessible locations.
2. Coordinate box and enclosure locations with work of other trades.
3. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
4. Box locations shown on drawings are approximate. Coordinate final locations in relations to spaces, equipment, wall construction, and finishes surrounding each outlet.
5. Locate boxes for light switches on strike side of doors unless prohibited by building construction. Verify switch locations not on the strike side of the door with Architect even if shown in alternate location on drawings.
6. Mount boxes plumb and level. Furnish extension rings as required by wall finish.
7. Open no more knockouts in boxes than required. Seal unused openings.
8. Do not install exposed boxes in finished areas without approval of Architect.
9. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Minimum horizontal separation between boxes mounted on opposite sides of a fire rated wall is 24-inches. Back to back outlets are not permitted.

    a. Where boxes must be installed in same vertical channel, provide a layer of expandable spray foam insulation around each box. Boxes installed in this manner shall be installed with a minimum 1-inch separation. Provide minimum 1-hour fire rated putty pad to cover outlets on one side of the partition.
10. Locate boxes so that cover or plate will not span different building finishes.
11. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
12. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
13. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
14. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
15. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

B. Recessed Boxes in Masonry Walls:

1. Align either top of box with top of masonry block or bottom of box with bottom of masonry block, whichever is closest to indicated mounting height. Do not exceed ADA or code mounting height requirements.

2. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

C. Mounting Heights:

1. Mount boxes at heights indicated. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
2. Coordinate location and mounting heights of all outlets with Architect before rough-in.
3. Mount boxes at heights indicated on Drawings.
4. Height of outlet boxes shall be as follows, unless noted otherwise on drawings:

a. Switches: 44 inches above finished floor.
b. Standard Receptacles: 18 inches above finished floor.
c. Standard Receptacles, Mounted Above Counter: 4 inches above counter backsplash, unless noted otherwise. Coordinate height with Architectural elevations before rough-in.
d. Receptacles on Exterior of Building: 24 inches above finished grade.
e. Receptacles on Rooftop: 24 inches above roof.
f. Other System Outlets: As indicated on drawings.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 26 84 13 "Penetration Firestopping."

3.8 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.9 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EPEC raceways and fittings.
2. Type ERMC-S raceways, elbows, couplings, and nipples.
3. Fittings for conduit, tubing, and cable.
4. Solvent cements.
5. Duct accessories.
6. Handholes and boxes for exterior underground wiring.
7. Duct sealing.

1.2 DEFINITIONS

A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.

B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.

C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.

D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Preinstallation Coordination Meeting(s): For underground ducts and raceways. Conduct meeting(s) as videoconferenceorat Project site before .

1. Attendees: Installers, fabricators, representatives of manufacturers, and administrants for field tests and inspections. Notify Architect, and Owner's Commissioning Authority of scheduled meeting dates.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For concrete and steel used in precast concrete structures, also include product certificates as required by ASTM C858.

B. Shop Drawings:

1. Precast or Factory-Fabricated Concrete Structures:

a. Include plans, elevations, sections, and details, including attachments to other Work.
b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
c. Include reinforcement details.
d. Include frame and cover design and manhole chimneys.
e. Include grounding details.
f. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and other accessories.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems" for products and installation requirements for underground applications.

2.2 TYPE EPEC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651A and UL CCN EAZX.

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

1. Blue Diamond Industries.
2. JM Eagle; J-M Manufacturing Co., Inc.
3. Petroflex North America.
4. Prysmian Cables and Systems; Prysmian Group North America.
5. Southwire Company.

C. Schedule 40 Electrical HDPE Underground Conduit (EPEC-40):

1. Dimensional Specifications: Schedule 40.

2.3 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL CCN DZYR.

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

1. ABB, Electrification Products Division.
2. Calconduit; Atkore International.
3. JM Eagle; J-M Manufacturing Co., Inc.
4. NAPCO; Westlake Chemical Corp.

5. Opti-Com Manufacturing Network, Inc (OMNI).
6. Topaz Lighting & Electric.

C. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Markings:

a. For use with maximum 90 deg C wire.

2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Metallic Fittings for Type ERMC, and Type PVC Raceways:

1. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

B. Metallic Fittings for Type EPEC and Type RTRC Raceways:

1. General Characteristics: UL 514B and UL CCN DWTT.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.5 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.
3. SustainabilityCharacteristics:

    a. VOC Content: [510][490]<Insert value> g/L or less for [PVC][CPVC] conduit and fittings.

2.6 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

B. Underground-Line Warning Tape: In accordance with Section 26 05 53 "Identification for Electrical Systems."

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

    a. ASTM C858 for design and manufacturing processes.
    b. SCTE 77.

B. Precast Concrete Handholes and Boxes:

1. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.
2. 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:

    a. A.C. Miller Concrete Products, Inc.
    b. Oldcastle Infrastructure Inc.; CRH Americas.

3. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
4. Frame and Cover:

    a. Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
    b. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    c. Cover Legend: Molded lettering, as indicated for each service.

5. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inch vertically and horizontally to accommodate alignment variations.

    a. Knockout panels must be located no less than 6 inch from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.

C. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:

1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. MacLean Highline.
    b. Oldcastle Infrastructure Inc.; CRH Americas.
    c. Quazite; Hubbell Incorporated, Power Systems.

3. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.

    a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    b. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATIONS", as applicable for each service.

5. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.
6. Duct Entrance Provisions: Duct-terminating fittings must mate with entering duct for secure, fixed installation in enclosure wall.
7. Handholes 12 inch wide by 24 inch long and larger must have factory-installed inserts for cable racks and pulling-in irons.
8. Options:

    a. Color: Gray.

2.8 DUCT SEALING

A. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Compound must be capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Duct sealing compound must be removable without damaging ducts or cables.

B. Inflatable Duct-Sealing System: Wraparound inflatable bladder that seals ducts that are empty or containing conductors against air and water infiltration. System is suitable for use in steel, plastic, or concrete ducts and penetrations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 31 10 00 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 31 10 00 "Site Clearing."

3.2 SELECTION OF UNDERGROUND DUCTS

A. Duct for Electrical Feeders 600 V and Less:PVC-40, concrete encased or direct buried as indicated on drawings. If not noted, duct shall be concrete encased.

B. Duct for Electrical Branch Circuits: PVC-40, direct buried unless otherwise indicated.

C. Underground Ducts Crossing Paved Paths, Walks, and Driveways: PVC-40, encased in reinforced concrete unless otherwise noted.

D. Underground Ducts Crossing Roadways: PVC-40, encased in reinforced concrete.

E. Stub-ups: Concrete encased, ERMC-S.

3.3 SELECTION OF UNDERGROUND ENCLOSURES

A. Handholes and Boxes:

1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
2. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
3. Cover design load must not exceed load rating of handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 31 20 00 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures.

3.5 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
2. Steel raceway, bends, and fittings in single duct run or duct bank must be of same type.
3. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
4. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.
5. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch.
6. Curves and Bends:

    a. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inch, both horizontally and vertically, at other locations unless otherwise indicated.
    b. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch. Use only equipment specifically designed for material and size involved. Use PVC heating bender for bending PVC conduit.
    c. Duct must have maximum of 180 degrees of bends between pull points.

7. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.

    a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch below grade or floor level and do not terminate in hubs.

8. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
9. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

a. Couple steel elbows to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.

10. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig hydrostatic pressure.
11. Pulling Cord: Install 200 lbf test nylon cord in empty ducts.
12. Concrete-Encased Ducts and Duct Bank:

a. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 31 20 00 "Earth Moving" for pipes 6 inch or less in nominal diameter.
b. Width: Excavate trench minimum 3 inch wider than duct on each side.
c. Depth: Install so top of duct envelope is at least 24 inch below finished grade in areas not subject to deliberate traffic, and at least 30 inch below finished grade in deliberate traffic paths for vehicles unless otherwise indicated. Install so top of duct envelope is below local frost line.
d. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
e. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
f. Minimum Space between Ducts: 3 inch between edge of duct and exterior envelope wall, 2 inch between ducts for like services, and 12 inch between power and communications ducts.
g. Elbows:

1) Use manufactured duct elbows for stub-ups and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
2) Use manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct run.

h. Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of equipment base.

1) Stub-ups must be minimum 4 inch above finished floor and minimum 3 inch from conduit side to edge of slab.

i. Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.

1) Stub-ups must be minimum 4 inch above] finished floor and no less than 3 inch from conduit side to edge of slab.

j. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

k. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
l. Concrete Cover: Install minimum of 3 inch of concrete cover between edge of duct to exterior envelope wall, 2 inch between duct of like services, and 4 inch between power and communications ducts.
m. Place minimum 6 inch of engineered fill above concrete encasement of duct.
n. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

1) Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions, or use other specific measures to prevent expansion-contraction damage.
2) If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch reinforcing-rod dowels extending minimum of 18 inch into concrete on both sides of joint near corners of envelope.

o. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 03 30 00 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

13. Underground-Line Warning Tape: Bury underground line specified in Section 26 05 53 "Identification for Electrical Systems" no less than 12 inch above concrete-encased duct and duct banks and approximately 12 inch below grade. Align tape parallel to and within 3 inch of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inch. Space additional tapes 12 inch apart, horizontally across width of ducts.
14. Ground ducts and duct banks in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Interfaces with Other Work:

1. Coordinate all underground site work with new and existing utilities and work of other Divisions.
2. Coordinate all underground electrical service work with utility company and utility company installation guidelines.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Reference Standards:

1. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Elevations:

a. Manhole Roof: Install with rooftop at least 15 inch below finished grade.
b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.

c. Install handholes with bottom below frost line, minimum 30 inches below grade.
d. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
e. Where indicated, cast handhole cover frame integrally with handhole structure.

2. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
3. Manhole Access: Circular opening in manhole roof; sized to match cover size.

a. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
b. Install chimney, constructed of precast concrete collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.

4. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07. After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
5. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 07 11 13 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
6. Hardware: 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.
7. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inch for manholes and 2 inch for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
8. Ground manholes, handholes, and boxes in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Interfaces with Other Work:

1. Coordinate all underground site work with new and existing utilities and work of other Divisions.
2. Coordinate all underground electrical service work with utility company and utility company installation guidelines.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Reference Standards:

1. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Install handholes and boxes with bottom below frost line, minimum 30 inches below grade.
5. 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 enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour concrete ring encircling, and in contact with enclosure entry, and with top surface screeded to top of box cover frame. Bottom of ring must rest on compacted earth.

    a. Concrete: 3000 psi, 28-day strength, complying with Section 03 30 00 "Cast-in-Place Concrete," with troweled finish.
    b. Dimensions: As indicated on drawings or as required by NFPA 70.

8. Ground handholes and boxes in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Interfaces with Other Work:

1. Coordinate all underground site work with new and existing utilities and work of other Divisions.
2. Coordinate all underground electrical service work with utility company and utility company installation guidelines.

3.8 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Owner authorities having jurisdiction.

B. Tests and Inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
3. Test grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.

1. Manufacturer's Field Reports for Field Quality-Control Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at Project site.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Pourable sealants.
7. Foam sealants.

B. Related Requirements:
1. Section 26 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:

1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Cast-Iron Wall Sleeves:

1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. PVC Molded Sleeves:

1. General Characteristics: With nailing flange for attaching to wooden forms.

D. PE or PP Molded Sleeves:

1. General Characteristics: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

E. Round, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch, thickness must be 0.052 inch.
2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inch, thickness must be 0.138 inch.

2.3 SLEEVE-SEAL SYSTEMS

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. Advance Products & Systems, Inc.
2. BWM Company.
3. CALPICO, Inc.
4. Flexicraft Industries.
5. GPT; a division of EnPRO Industries.
6. Metraflex Company (The).
7. Proco Products, Inc.

B. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

C. Options:

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.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.6 POURABLE SEALANTS

A. Performance Criteria:

1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.

a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.7 FOAM SEALANTS

A. Performance Criteria:

1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting. Core-drilled holes for above grade floor penetrations do not need to be sleeved, except where indicated on drawings. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
3. Cut sleeves to length that extends 6 inches beyond face of wall on each side. Deburr after cutting and provide insulating bushing on both ends.

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

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

G. Underground, Exterior-Wall and Floor Penetrations:

1. New Construction: Install steel or cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

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

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels, including arc-flash warning labels.
8. Miscellaneous identification products.

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 electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 26 05 73 "Power System Studies" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Warning labels and signs shall include, but are not limited to, the following legends:

1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
2. Critical Research/Critical Power warning: Apply labeling on all switchgear, switchboards, distribution panels, and panelboards that are feeding critical research or power, from end-user equipment upstream to service entrance. Labeling shall read: "CRITICAL RESEARCH OR POWER IS FED FROM HERE. CONTACT FACILITY COORDINATOR IF A SHUTDOWN IS REQUIRED."

B. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Labels:

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:

a. Brady Corporation.
b. Brother International Corporation.
c. Grafoplast Wire Markers.
d. Ideal Industries, Inc.
e. Panduit Corp.

2. Preprinted, 3-mil-thick, polyester flexible label with acrylic pressure-sensitive adhesive.
a. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized to fit the raceway diameter, such that the clear shield overlaps the entire printed legend.
3. Polyester, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

a. Nominal Size: 3-1/2 by 5 inches

4. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
5. Marker for Tags: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

2.4 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

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:

    a. Carlton Industries, LP.
    b. HellermannTyton.
    c. Marking Services, Inc.
    d. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

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

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Marking Services, Inc.

C. Underground-Line Warning Tape:

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:

    a. Brady Corporation.
    b. Ideal Industries, Inc.
    c. Marking Services, Inc.
    d. Reef Industries, Inc.

2. Tape:

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

3. Color and Printing:

    a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

b. Inscriptions for Red-Colored Tapes: "CAUTION BURIED HIGH VOLTAGE LINE BELOW" or “CAUTION BURIED ELECTRIC LINE BELOW" .

4. Tag: :

a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 6 inches.
c. Overall Thickness: 5 mils.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 56 lb/1000 sq. ft..
f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

2.5 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

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:

a. Brady Corporation.
b. Carlton Industries, LP.
c. Marking Services, Inc.

2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. in., minimum 1/16 inch thick.
b. For signs larger than 20 sq. in., 1/8 inch thick.
c. Engraved legend with colors as indicated below by type of service:

1) Normal Power: Black background, white letters
2) Emergency/Life Safety Power: Red background; white letters.

d. Punched or drilled for mechanical fasteners.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 CABLE TIES

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. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg Faccording to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

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

D. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

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

F. Attach signs and plastic labels that are not self-adhesive type with stainless steel mechanical fasteners appropriate to the location and substrate.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

I. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

J. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

K. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways, more than 600 V: Paint red.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, handholes, panelboards, and branch circuits, use color-coded conductor tape to identify the phase.

1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and/or branch-circuit conductors.
    a. Color shall be factory applied or field applied for sizes larger than No. 12 AWG if authorities having jurisdiction permit.
    b. Colors for 208/120-V Circuits:
        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.
    c. Colors for 480/277-V Circuits:
        1) Phase A: Brown.
        2) Phase B: Orange.
        3) Phase C: Yellow.
    d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inchesfrom terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

2. Label conductors landed at each breaker, 100A/3P and above, with the following:

    a. Circuit breaker position identification
    b. Phase information ("A", "B", or "C")
    c. Labels shall be readably visible once the deadfront cover is removed. Install so that it is wrapped around the cable and adhered to itself so that the cable heating and cooling does not cause the label to fall off.
    d. Example: CB#1-A, CB#1-B, CB#1-C.

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

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

G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

1. Install underground-line warning tape for direct-buried cables and cables in raceways.

J. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.

1. Comply with NFPA 70E and ANSI Z535.4.
2. Comply with Section 26 05 73 "Overcurrent Protective Device Coordination Study" requirements for arc-flash warning labels.

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation..

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

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine plastic label, punched or drilled for mechanical fasteners. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 incheshigh.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
d. Enclosed switches.
e. Contactors.

END OF SECTION

SECTION 26 05 73 – POWER SYSTEM STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. Section includes computer-based, power systems study with the following sections:

1. Overcurrent protective device coordination study to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
2. Fault current study to determine the minimum interrupting capacity of circuit protective devices.
3. Arc-Flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

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

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

D. SCCR: Short-circuit current rating.

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

1.4 ACTION SUBMITTALS

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

B. Other Action Submittals: Submittals shall be in digital form. Upload electronic submittals using Owner's web-based file transfer system.

1. Power system study input data, including completed computer program input data sheets.

a. Obtain from the Office of Physical Plant a letter listing the electrical characteristics of the service to be used in the power study. Letter shall be on PSU letterhead, signed by the OPP engineer, or shall be in an email with the engineer's official email signature.
b. Electrical service characteristics to be included in the letter shall be:

1) Primary and secondary voltage at the service transformer
2) Size of the service transformer
3) Available fault current at the primary connections of the transformer (three phase fault current and phase to ground fault current)
4) X/R ratio of the transformer (positive sequence and zero sequence)
5) Impedance (%Z) of the transformer
6) Any other characteristics unique to the installation

2. Detailed Arc Flash Study Option Report.
3. Study and equipment evaluation reports; Signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Owner (Project Manager (PM) and Engineering Services Electrical Group)/Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

4. Revised single-line diagram, reflecting field investigation results and results of power system study. This shall include the following:

a. The single-line generated by the computer software program used for the study and documented in the report, with labels and data as indicated in section 2.2 C. of this specification.
b. Updated CAD generated one-lines for use by Owner. At a minimum, the format should capture single-line detail (name, voltage, bus size, SCCR, circuit breaker sizes and quantities) for equipment including switchgear, switchboards, and distribution panels. Appliance panelboards should indicate name, voltage, frame size, and main type (MLO or MCB and size). Layouts must be clearly labeled and legible in 24"x36" format.

1) Note: SCCR information shall be documented on a NON-PLOT CAD layer
2) Layout shall be riser format, including floor level numbers. Do not include room numbers.

c. Panelboard locations from field investigation shall be documented and labeled in CAD format on Block Plans and turned over to Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist.

B. Product Certificates: For overcurrent protective device coordination study software (short-circuit and arc-flash hazard studies), certifying compliance with IEEE 399, IEEE1584, and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. The following parts from the Power System Study Report:

1) One-line diagram in .pdf and .dwg format per section 1.4 B. 3.b.

a) Provide one (1) full size (24”x36”), laminated hard copy of the system one-line.

2) Complete power system model in SKM format.

a) The contractor is required to provide the study project files to the Owner in electronic format.
b) Include all associated library and directory files.

3) Time-current coordination curves.
4) Arc Flash Labels.

b. Power system data.

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

1.7 QUALITY ASSURANCE

A. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located and has a minimum of 5 years’ experience utilizing the program. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by the following:

1. SKM Systems Analysis, Inc

B. Comply with IEEE 242, IEEE 399, IEEE 1584, and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

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

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary shall include deficiencies and recommendations as found by the study.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations, ampere ratings, and short-circuit (AIC) rating of equipment.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Available fault current at each piece of equipment.

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

E. Short-Circuit Study Report: Present information in table format of report summary with nameplate and calculated values and compare with percentages.

1. Protective Device Evaluation:

a. Evaluate equipment and protective devices and compare to short-circuit ratings.

1) Where available fault current is 90% or more of the equipment’s rating, highlight row in red.
2) Where available fault current is greater than 80% of the equipment’s rating and less than 90%, highlight row in yellow.

b. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.

c. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2–cycle symmetrical fault current.
d. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2–cycle symmetrical fault current.
e. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault current.

2. Short-Circuit Study Output:

a. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

1) Voltage.
2) Calculated fault-current magnitude and angle.
3) Fault-point X/R ratio.
4) Equivalent impedance.

b. Momentary Duty Report:

1) Voltage.
2) Calculated symmetrical fault-current magnitude and angle.
3) Fault-point X/R ratio.
4) Calculated asymmetrical fault current:

a) Based on fault-point X/R ratio.
b) Based on calculated symmetrical value multiplied by 1.6.
c) Based on calculated symmetrical value multiplied by 2.7.

c. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

1) Voltage.
2) Calculated symmetrical fault-current magnitude and angle.
3) Fault-point X/R ratio.
4) No AC Decrement (NACD) ratio.
5) Equivalent impedance.
6) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
7) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Protective Device Coordination Study:

1. Report existing, where applicable, and recommended settings of protective devices, ready to be applied in the field (may be provided in table format). Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

b. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes/scenarios and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

   a. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
   b. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
   c. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
   d. Cables and conductors damage curves.
   e. Ground-fault protective devices.
   f. Motor-starting characteristics and motor damage points.
   g. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Provide adequate time margins between device characteristics such that selective operation is achieved per IEEE 242.
6. Comments and recommendations for system improvements.

H. Arc-Flash Study Output:

1. Interrupting Duty Report: Provide in table format based on measures taken to reduce incident energy. Provide normal, emergency, and reduced energy let-through settings for each device. Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis. Provide worst case value.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis. Provide worst case value.

2. When OCPD setting changes are recommended based on previous section G, verify no changes to available incident energy occur. Where breaker setting changes affect the arc-flash output, document impacted values in separately labeled table.

I. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

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

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems." Produce a 3.5-by-5-inchthermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation and fed from location
2. Nominal voltage.
3. Flash protection boundary (Restricted and Limited).
4. Incident energy.
5. Working distance.
6. Engineering report number, Engineering Company Name, revision number, and issue date.
7. Label format shall comply with samples published on the PSU OPP Design and Construction Standards web site.

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

1. For equipment with separate “maintenance mode” settings, a separate Arc Flash label shall be installed. “Maintenance mode” labels shall be printed in blue.
2. Equipment with incident energy levels above 40 cal, a red “Danger” label shall be installed per requirements in Section 26 05 53 “Identification for Electrical Systems.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Owner.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

3. For equipment that is either relocated or existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification approved by owner.

1. Product Data for Project's overcurrent protective devices 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. Power sources and ties.
3. Full-load current of all loads.
4. Voltage level at each bus.
5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Motor horsepower and NEMA MG 1 code letter designation.
8. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
9. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

C. 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.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted prior to coordination study may not be used in study.

a. This process should occur concurrently with equipment submittal reviews and prior to approval, sign-off, and purchase order of associated equipment. Coordinate with PM and Engineering Services Electrical Group as necessary.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

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

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings and noted herein.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Analysis shall extend to all panelboards included in project, as well as mechanical equipment included in the Mechanical-Electrical Coordination Schedule that have an available fault current listed.

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

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
2. Motors supplied by VFDs shall be considered to contribute no fault, unless they are known to operate in bypass mode.

H. Calculate short-circuit duties for a three-phase bolted fault at each of the following:

1. Low-voltage switchgear.
2. Branch circuit panelboards.
3. Disconnect switches.

I. Short Circuit Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

G. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

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

I. The study shall demonstrate that the protective devices as selected and set will ensure that the minimum unfaulted load is interrupted when protective devices isolate a fault or overload anywhere in the system while satisfactory protection is provided for equipment against overloads and short circuits are interrupted as rapidly as possible.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the cable schedule and one-line diagram on Drawings. Call discrepancies to the attention of the Owner/PSU Engineering Services Electrical Group.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who is approved by owner.

1. Short-circuit current at each system bus, three phase and line-to-ground as obtained from the Short-Circuit study completed prior.
2. Maximum demands from service meters.
3. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.

b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. 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 SCCR in amperes rms symmetrical.
j. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.5 ARC-FLASH HAZARD ANALYSIS

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

B. Calculate maximum and minimum contributions of fault-current size for normal, emergency, and maintenance mode settings.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

C. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

D. Include medium- and low-voltage equipment locations, except equipment rated 240 VAC or less fed from transformers less than 125 kVA.

E. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

G. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

H. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

I. Report shall include recommendations of reducing fault current levels and enhancing worker safety.

1. Provide arc-flash reduction maintenance settings if specified.

3.6 LABELING

A. Apply arc-flash label(s) as required for 600-V ac, 480-V ac, and 208-V ac panelboards and disconnects and for each of the following locations:

1. Panelboard.
2. Transformers (secondary compartment).
3. Disconnects and enclosed circuit breakers.

B. Any equipment excluded from study by IEEE 1584 should receive, at a minimum, a generic arc flash warning label. Review approach with PSU Engineering Services Electrical Group prior to performing calculations.

3.7 APPLICATION OF WARNING LABELS

A. Prior to final printing of adhesive type labels. The study specialist must print paper copies of all labels for approval by Engineering Services. The study specialist shall field install (tape up) the printed paper copies. Once paper copies have been installed, the study specialist shall have the labels verified by PSU Electrical Integrity crew. Upon approval by PSU Electrical Integrity crew and Engineering Services Electrical Group, the study specialist shall print the final adhesive labels and field install in same locations as the printed labels.

B. Install the arc-fault warning labels under the on-site supervision and control of the Arc-Flash Study Specialist.

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electronic time switches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings:

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

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

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.
6. TE Connectivity Ltd.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Contact Configuration: DPDT.
3. Contact Rating: 30 A inductive or resistive, 240 V(ac) 20 A ballast load, 120/240 V(ac).
4. Programs:

a. Two channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.

5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
6. Astronomic Time: All channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

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

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

B. Description: Solid state, with DPST dry contacts rated for 1000 W incandescent or 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure[from same source and manufacturer as switch].
6. Failure Mode: Luminaire stays ON.

2.3 LINE VOLTAGE TIMER SWITCHES

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

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Legrand North America, LLC (Wattstopper).
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.
6. TE Connectivity Ltd.

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in ten minute increments.

1. Rated 960 W at 120 V(ac) for tungsten lighting, 10 A at 120 V(ac) or 10 A at 277 V(ac) for fluorescent or LED lighting, and 1/4 hp at 120 V(ac).
2. Standards: Comply with UL 20.
3. Integral relay for connection to BAS.
4. Voltage: Match the circuit voltage.
5. Color: As specified in Section 26 27 26 "Wiring Devices".

2.4 LIGHTING CONTACTORS

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

1. ABB (Electrification Products Division).
2. Allen-Bradley/Rockwell Automation.
3. ASCO: a brand of Vertiv.
4. Eaton.
5. Leviton Manufacturing Co., Inc.
6. Schneider Electric USA (Square D).

B. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

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

3.2 INSTALLATION OF PHOTOSENSORS

A. Install photosensors where indicated on drawings.

B. Controls installed on roof shall be mounted 2 feet above roof surface, unless noted otherwise.

C. Coordinate aiming of photosensors in field. Sensors shall be installed facing north whenever possible. Aim sensors away from sources of artificial light that may interfere with sensor operation.

3.3 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.

C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 26 05 53 "Identification for Electrical Systems.

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:

1. Lighting control devices will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

D. Manufacturer Services:

1. Engage factory-authorized service representative to supervise field tests and inspections.

END OF SECTION

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. Section Includes: Distribution, dry-type transformers rated 600 V and less, with capacities up to 1000 kVA.

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 and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

    a. Performance Data requirements:

        1) No load and full load losses per NEMA ST20
        2) Linear load Efficiency data @ 1/6, 1/4, 1/2, 3/4 & full load

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

C. Verification of meeting efficiency standard criteria.

D. Manufacturer’s recommended clearances around transformer.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

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. Eaton.
2. General Electric Company.
3. Powersmiths International Corp.
4. Siemens Power Transmission & Distribution, Inc.
5. Square D; by Schneider Electric.
6. Hammond Power Solutions.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

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. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

D. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper

E. Encapsulation: Transformers smaller than 15 kVA shall have core and coils completely resin encapsulated.

F. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

G. Transformers shall meet DOE 10 CFR Part 431 for energy efficiency requirements.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70 and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated.

1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound utilizing a vacuum pressure impregnation process to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: NSF/ANSI 61 gray.

E. Taps for Transformers: Two 2.5 percent taps FCAN and four 2.5 percent taps FCBN.

F. Insulation Class, 15 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

G. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to NEMA ST20.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, metal nameplate for each transformer, mounted with corrosion-resistant screws.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.

8. Insulation Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance meet requirements in 260526.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

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

3.2 INSTALLATION

A. Install transformers level and plumb on a concrete base with vibration-dampening supports.

B. Construct concrete bases according to Section 03 30 00 "Cast-in-Place Concrete" Section 03 30 53 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

1. Coordinate transformer install with housekeeping pad or floor mounted install per location and design documents.
2. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Secure transformer to concrete base according to manufacturer's written instructions.

D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

E. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

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

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters. Including all optional tests unless waived by Owner.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Infrared Scanning: After Substantial Completion and building occupancy, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period no more than four months after substantial completion and building occupancy. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltage and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. HID: High-intensity discharge.

D. MCCB: Molded-case circuit breaker.

E. SPD: Surge protective device.

F. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
3. Engineering power studies and panelboard product data must be submitted and approved by PSU Engineering Services Electrical Group prior to final approval of the panelboard shop drawings and prior to any release of equipment for manufacture.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

B. 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.
4. Reports must be submitted to PSU Engineering Services Electrical Group for approval prior to closeout of project.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI Types: Two spares for each panelboard.
3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 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 NECA 407 and NEMA PB 1.

1.10 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 to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. 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 two weeks in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

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

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush-mounted or surface-mounted, dead-front cabinets, as indicated on Drawings.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Height: 84 inches maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
4. Finishes:

a. Panels and Trim: 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: Same finish as panels and trim.

E. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

F. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

a. Plating shall run entire length of bus.
b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

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

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

H. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. AIC ratings for electrical equipment:

a. Panelboards 240 VAC or less: minimum 22,000 AIC

2. The AIC ratings for electrical equipment shall be verified by the Power Study, upsizing of AIC rating may be required. The Design Professional shall bare responsibility to ensure the proper AIC rating is chosen for a specific piece of equipment.

J. Panels shall have complete bus and mounting hardware requiring only the installation of additional breakers for future expansion.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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. Eaton.
2. Square D (Basis of Design).
3. Siemens.

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

C. Mains: Refer to Schedules on Drawings.

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

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

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

G. Group installed panelboards shall have separate trim.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Equipment serving intensive research facilities and/or labs should be provided with 100% rated breakers. The distribution equipment upstream of the main switchboard/switchgear should also be considered for application.

1. 100% rated breakers shall be installed on a case-by-case basis with approval from PSU Engineering Services Electrical Engineering Group.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 100A up to 225A.

2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
3. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
h. Rating Plugs: Three-pole breakers with ampere ratings greater than 225 amperes shall have interchangeable rating plugs
i. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
2. Circuit directory shall denote source of power.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

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. Comply with NECA 1.

C. Location:

1. Panelboards serving loads in only one room: Locate within room.
2. Panelboards serving loads in more than one room: Locate in electrical closet, corridor, or other accessible space.
3. Panelboards shall not be installed in janitor closets or dedicated telecom closets.

D. Install panelboards and accessories according to NECA 407.

E. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

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

G. Mount top of trim 90 inches above finished floor unless otherwise indicated.

1. Verify that the operating handle of top-most switch or circuit breaker, in on position, is not higher than 79 inches above finished floor or grade.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars. Comply with requirements in 260526 “Grounding and Bonding for Electrical Systems”.

M. Install filler plates in unused spaces.

N. Stub 1 inch conduit for every three spare poles to a point above the suspended ceiling.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

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 panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Test MCCBs with ampere rating of 100A or higher per NETA ATS, including primary injection testing. A testing agency (as specified in other equipment specification sections) shall include this in their scope of work.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Infrared Scanning: After Substantial Completion and building occupancy, perform an infrared scan of panelboard connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform two follow-up infrared scans of panelboards, one at four months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying panelboards checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

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

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. 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 Section 26 05 73 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

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. Switches and fan-speed controller switches.
2. Straight-blade receptacles.
3. Receptacles with arc-fault and ground-fault protective devices.
4. Locking receptacles.
5. Special-purpose power outlet assemblies.
6. Connectors, cords, and plugs.

1.3 RELATED SECTIONS

A. Section 26 09 23 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.4 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Field quality-control reports.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer.

B. Sample warranties.

1.7 WARRANTY FOR DEVICES

A. Provide manufacturer standard warranty.

PART 2 - PRODUCTS

2.1 GENERAL WIRING DEVICE REQUIREMENTS

A. Manufacturers: Subject to compliance with requirements, provide devices from one of the following:

1. Hubbell Wiring Devices.
2. Pass and Seymour / Legrand.
3. Eaton / Cooper.
4. Leviton.

B. Wiring devices shall be heavy-duty, specification grade, unless noted otherwise.

C. Wiring devices shall be "weather-resistant" type where installed in wet or damp locations.

1. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Provide tamper-resistant wiring devices in all areas required by the National Electrical Code.

E. Wiring devices shall be back and side wired, unless noted otherwise.

F. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

G. Comply with NFPA 70.

H. Comply with NEMA WD 1.

I. Device and Wall Plate Colors:

The device and wall plate color combinations below are for all wiring devices served by the system indicated, unless otherwise specified here or on the drawings or required by NFPA.

1. Normal Power System (standard device and wall plate color):

a. White device .

J. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. General Requirements

1. All switches shall be rated 120/277V, 20A unless noted otherwise.
2. Switches shall have anti-microbial finish where indicated on drawings.

a. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.

B. Toggle Switch

1. Description: Single or double pole, three-way or four-way as indicated on drawings.
2. Reference Standards: UL CCN WMUZ and UL 20.

2.3 SPECIFICATION GRADE STRAIGHT-BLADE RECEPTACLES

A. Standard Receptacle

1. Simplex or duplex as indicated.
2. Description: Two pole, three wire, and self-grounding.c
3. Reference Standards: UL CCN RTRT and UL 498.
4. Configuration: NEMA WD 6, Configuration 5-20R.

B. Special Receptacles

1. Simplex, NEMA configuration as indicated on drawings.
2. Voltage and poles as required by indicated NEMA configuration.

2.4 RECEPTALCES WITH ARC-FAULT AND GROUND-FAULT PROTECTIVE DEVICES

A. General Requirements:

1. All GFCI receptacles shall be UL 498, UL 943 compliant.

a. Self-Test Function: Periodic, automatic testing of ground fault module. If test fails, receptacle shall deny power or provide visual and/or audible notification.
b. Line-Load Reversal Function: If line power is connected to load terminals, power to receptacle face shall be denied.
c. Trip Threshold: 5 mA plus or minus 1 mA, Class A.
d. Trip Time: 0.025 seconds.
e. Test and reset buttons. Indicator light to indicate tripped condition.
f. Automatic grounding feature.

2. Install in accordance with manufacturer's instructions.

B. Standard GFCI Receptacle

1. Duplex.
2. Configuration: NEMA WD 6, Configuration 5-20R.

2.5 LOCKING RECEPTACLES

A. Special Receptacles

1. Simplex, NEMA configuration as indicated on drawings.
2. Voltage and poles as required by indicated NEMA configuration.
3. Material and Color: Black nylon.
4. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Automatic grounding feature.

B. CONNECTORS, CORDS, AND PLUGS

1. Cord and Plug Sets

a. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
b. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
c. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 WALL PLATES

A. General Requirements

1. Single Source: Obtain wall plates from same manufacturer of wiring devices.
2. Single and combination types shall match corresponding wiring devices.
3. Plate-Securing Screws: Metal with head color to match plate finish.

B. Interior:

1. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
2. Material for Unfinished Spaces: Galvanized steel.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, impact-resistant polycarbonate with lockable cover.

1. NEMA 3R rating while in use, hinged cover clearly marked "Suitable for Wet Locations While in Use".
2. Gasketing between enclosure and mounting surface and ebtween hinged cover and mounting plate/base.
3. Stainless steel mounting screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 GENERAL INSTALLATION

A. Comply with NECA 1.

B. Owner, through Architect, reserves the right to move any outlet or stubbed-up conduit, a distance of twenty-five feet before roughing-in, without additional cost to Owner.

C. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. If the designated location of a switch or receptacle places it partially between two finishes, the actual location shall be adjusted to set the plate entirely on one finished surface only. Actual height shall not exceed mounting heights indicated herein or required by codes.
5. Outlet boxes for flush mounted wiring devices installed in masonry shall be installed so bottom of outlet box coincides with bottom of block or brick that is below specified mounting height, and actual height shall not exceed mounting heights indicated herein or required by code.
6. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Straighten conductors that remain and remove corrosion and foreign matter.
b. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

E. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.3 INSTALLATION OF GFCI RECEPTACLES

A. Do not wire GFCI receptacles for downstream protection.

B. Install GFCI receptacles in all locations where required by NFPA 70, even where not indicated on drawings.

C. At a minimum, install GFCI receptacles, or receptacles protected by GFCI circuit breakers, in the following locations:

1. All toilet rooms.
2. Within six feet of any sink, lavatory, or mop receptor.
3. Within twenty-five feet of all HVAC equipment as required by NFPA 70.
4. All outdoor locations.
5. All kitchens located in spaces defined as "other than dwelling units".

3.4 INSTALLATION OF SWITCHES

A. Install switches with 'off' position down. Where multi-way switches are installed in a room, lights shall be off when all toggle switches are down.

B. Locate switch outlets on strike side of door, unless otherwise indicated or unless building construction prohibits installation on strike side of door. Verify mounting location with Architect if mounting on strike side of door is not possible if alternate location is not indicated on drawings.

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.7 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.8 FIELD QUALITY CONTROL OF CORD REELS AND FITTINGS

A. Nonconforming Work:

1. Components and assemblies will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

B. Assemble and submit test and inspection reports.

3.9 FIELD QUALITY CONTROL OF CONNECTORS, CORDS, AND PLUGS

A. Tests and Inspections:

1. Perform tests and inspections indicated in manufacturer's instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.10 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems." Identify each receptacle with panelboard identification and circuit number.

B. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.11 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.

B. Connectors, Cords, and Plugs:

1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 28 13 - FUSES

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. Cartridge fuses rated 600V and less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
4. Coordination charts and tables and related data.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Closeout Procedures and Operation and Maintenance Data specifications include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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 three 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. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.
4. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK1: 250V or 600V, zero to 600A rating, 200 kAIC, time delay.
2. Type RK5: 250V or 600V, zero to 600A rating, 200 kAIC, time delay.
3. Type J: 600V, zero to 600A rating, 200 kAIC, fast acting or time delay as noted.

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. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 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.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Feeders:

   a. Up to and including 800A: Class RK1, time delay or Class J, time delay.

2. Motor Branch Circuits: Class RK1, time delay.
3. Power Electronics Circuits: Class J, high speed.
4. Other Branch Circuits: Class RK1, time delay or Class RK5, time delay.
5. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

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

B. Do not install fuses until installation of equipment is complete and inspections have been completed prior to energization, including cleaning, tightening of electrical connections, inspection of ground and grounding conductors, and conductor insulation tests.

C. Do not ship equipment with fusing in place.

END OF SECTION

SECTION 26 29 13.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

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. Manual motor controllers.
2. Enclosures.
3. Identification.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. NC: Normally closed.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SCPD: Short-circuit protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.

6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.

    a. Listing document proving Type 2 coordination.

7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

    a. Routine maintenance requirements for magnetic controllers and installed components.
    b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
    c. Manufacturer's written instructions for setting field-adjustable overload relays.
    d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
    e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; .

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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 use.

B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.

C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

2.2 ACCEPTABLE MANUFACTURERS

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

1. ABB.
2. Square D; by Schneider Electric.
3. Eaton.
4. Siemens Industry, Inc.; Energy Management Division.

2.3 MANUAL MOTOR CONTROLLERS

A. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Configuration: Nonreversing.
2. Overload Relays: NEMA ICS 2, bimetallic class as schedule on Drawings.
3. Pilot Light: Red.

2.4 ENCLOSURES

A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.

B. The construction of the enclosures shall comply with NEMA ICS 6.

C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.5 IDENTIFICATION

A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 26 05 53 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

B. Arc-Flash Warning Labels:

1. Comply with requirements in Section 26 05 73 "Power Systems Studies." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems" unless otherwise indicated.

C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.
e. Inspect contactors:

1) Verify mechanical operation.
2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.

f. Motor-Running Protection:

1) Verify overload element rating is correct for its application.
2) If motor-running protection is provided by fuses, verify correct fuse rating.

g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:

a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
c. Test motor protection devices according to manufacturer's published data.
d. Test circuit breakers as follows:

1) Operate the circuit breaker to ensure smooth operation.
2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.

e. Perform operational tests by initiating control devices.

C. Motor controller will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 SYSTEM FUNCTION TESTS

A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of sensing devices, alarms, and indicating devices.

B. Motor controller will be considered defective if it does not pass the system function tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

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 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of light source and luminaire, or both.

G. Luminaire: Complete lighting unit, including light source, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Submittal Process

1. Luminaires shall be submitted separately from lighting controls. Combined luminaire and controls submittals will be rejected without review.
2. Luminaire submittals shall be complete and contain all fixtures listed in the Lighting Fixture Schedule. Partial, incomplete, or preliminary submittals for luminaires will be rejected without review.
3. Luminaire submittals shall clearly indicate all equipment, features, models, accessories, and the like either by highlighting the appropriate options or by writing the manufacturer's complete model number on the product information sheet. Cutsheets without specific product characteristics indicated will be rejected without review.
4. Substitutions to the specified luminaires may be considered if submitted to the Designer at least fourteen days in advance of the bid. Substitutions not submitted within that deadline will not be considered.
5. Exceptions to the above are at the discretion of the lighting designer/reviewer.

B. Product Data: For each type of product.

1. Arrange in order as listed in Lighting Fixture Schedule.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Lighting Fixture Schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Access panels.
    e. Ceiling-mounted projectors.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. List of all lamp types used on the Project; use ANSI and manufacturers' codes.
2. Name and address of one or more service agencies for installed equipment.
3. Approved shop drawings indicating all selected options for each piece of lighting equipment.
4. Summary of required actions for routine maintenance and cleaning.

1.6 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

B. Store products in a clean, conditioned, dry space, protected from weather and in manufacturer's original packaging until ready for installation.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Minimum five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

B. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

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

B. Factory-Applied Labels: Comply with UL 1598 or CSA C22.2. Include recommended lamps. Locate labels 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 characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. Nominal Operating Voltage: As indicated on Lighting Fixture Schedule.

E. Color Rendering Index (CRI): As indicated on Lighting Fixture Schedule.

F. Correlated Color Temperature (CCT): As indicated on Lighting Fixture Schedule.

G. LED Lifetime: As indicated on Lighting Fixture Schedule. Lifetime shall be considered a predicted time where average lumen output reaches 70 percent of initial output as measured in accordance with IESNA LM-80 testing requirements.

H. LED boards and drivers: Field replaceable. Access, service, and replacement of boards and drivers shall be accomplished without removal of ceiling system or other building systems.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A 240/240 M.

D. Galvanized Steel: ASTM A 653/A 653M.

E. Aluminum: ASTM B 209.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Verify luminaire quantities, lengths, clearances, and other characteristics with these specifications, the Drawings, the Lighting Fixture Schedule, and other contract documents. Discrepancies or variances in these documents shall be communicated to the Design Team and Owner at the time the bid submission is made.

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

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install luminaires with reflectors, lenses, or lamps oriented in the same direction unless otherwise indicated.

D. Install luminaires so labels are not visible under normal operating conditions.

E. Install luminaires with hardware and accessories compatible with the approved ceiling system.

F. Install remote drivers and low-voltage transformers in accessible and maintainable locations.

G. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

H. Flush-Mounted Luminaires:

1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

I. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

J. Suspended Luminaires:

1. Ceiling or Structure Mount:

a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.

2. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

K. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

L. Fire Rating: Installation of luminaires in fire rated ceilings or walls shall maintain the fire rating of the assembly.

M. Insulation Contact Rating: Installation of luminaires in insulated ceilings shall have an enclosure rated for insulation contact (IC).

N. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

3.7 CLEANING

A. Remove protective coverings, dirt, dust, debris, fingerprints, and any other foreign material upon completion of project.

B. Replace broken, scratched, or otherwise damaged lenses, reflectors, or other luminaire parts upon completion of project without expense to Owner.

END OF SECTION

SECTION 26 52 13 - EMERGENCY AND EXIT LIGHTING

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. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Submittal Process

1. Luminaires shall be submitted separately from lighting controls. Combined luminaire and controls submittals will be rejected without review.
2. Luminaire submittals shall be complete and contain all fixtures listed in the Lighting Fixture Schedule. Partial, incomplete, or preliminary submittals for luminaires will be rejected without review.
3. Luminaire submittals shall clearly indicate all equipment, features, models, accessories, and the like either by highlighting the appropriate options or by writing the manufacturer's complete model number on the product information sheet. Cutsheets without specific product characteristics indicated will be rejected without review.
4. Exceptions to the above are at the discretion of the lighting designer/reviewer.

B. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Arrange in order as listed in Lighting Fixture Schedule.
2. Include data on features, accessories, and finishes.
3. Include physical description of the unit and dimensions.
4. Battery and charger for light units.
5. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
6. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. 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 Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. External Type: Self-contained, modular, battery-inverter unit, remote mounted from luminaire.

1. Emergency Connection: Operate luminaire continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
2. Operation: Relay automatically turns luminaire on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Luminaire automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects luminaire from battery, and battery is automatically recharged and floated on charger.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. 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 a flashing red LED.

2.2 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Lighting Unit:

1. Emergency Lighting Unit: As indicated on Lighting Fixture Schedule.

C. Remote Emergency Lighting Units:

1. Emergency Lighting Unit: As indicated on Lighting Fixture Schedule.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Exit Signs: As indicated on Lighting Fixture Schedule.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.5 METAL FINISHES

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

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.

D. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units , batteries, signs, or luminaires that are defective.

a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION

SECTION 26 56 00 - EXTERIOR LIGHTING

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. Exterior luminaires.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Submittal Process

1. Luminaires shall be submitted separately from lighting controls. Combined luminaire and controls submittals will be rejected without review.
2. Luminaire submittals shall be complete and contain all fixtures listed in the Lighting Fixture Schedule. Partial, incomplete, or preliminary submittals for luminaires will be rejected without review.
3. Luminaire submittals shall clearly indicate all equipment, features, models, accessories, and the like either by highlighting the appropriate options or by writing the manufacturer's complete model number on the product information sheet. Cutsheets without specific product characteristics indicated will be rejected without review.
4. Exceptions to the above are at the discretion of the lighting designer/reviewer.

B. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.

    a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

C. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1. Name and address of not less than one service agency for installed equipment.
2. Approved shop drawings indicating all selected options for each piece of lighting equipment.
3. Summary of required actions for routine maintenance and cleaning.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Drivers: One for every 10 of each luminaire type installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

B. Store products in a clean, conditioned, dry space, protected from weather and in manufacturer's original packaging until ready for installation.

1.9 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Minimum five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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

B. UL Compliance: Comply with UL 1598.

C. Nominal Operating Voltage: As indicated on Lighting Fixture Schedule.

D. Color Rendering Index (CRI): As indicated on Lighting Fixture Schedule.

E. Correlated Color Temperature (CCT): As indicated on Lighting Fixture Schedule.

F. LED Lifetime: As indicated on Lighting Fixture Schedule. Lifetime shall be considered a predicted time where average lumen output reaches 70 percent of initial output as measured in accordance with IESNA LM-80 testing requirements.

G. LED boards and drivers: Field replaceable.

H. Internal driver.

I. In-line Fusing: Separate in-line fuse for each luminaire.

J. Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.2 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Form and support to prevent warping and sagging.

C. 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.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended LED replacement components. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specificLED type.
b. CCT and CRI for all luminaires.

2.3 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and ceilings for suitable conditions where luminaires will be installed.

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

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base as indicated on drawings.

3.4 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 Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

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 project requirements.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

3.8 CLEANING

A. Remove protective coverings, dirt, dust, debris, fingerprints, and any other foreign material upon completion of project.

B. Replace broken, scratched, or otherwise damaged lenses, reflectors, or other luminaire parts upon completion of project without expense to Owner.

END OF SECTION

SECTION 26 56 13 - LIGHTING POLES AND STANDARDS

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. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete luminaire.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Submittal Process

1. Luminaires shall be submitted separately from lighting controls. Combined luminaire and controls submittals will be rejected without review.
2. Luminaire submittals shall be complete and contain all fixtures listed in the Lighting Fixture Schedule. Partial, incomplete, or preliminary submittals for luminaires will be rejected without review.
3. Luminaire submittals shall clearly indicate all equipment, features, models, accessories, and the like either by highlighting the appropriate options or by writing the manufacturer's complete model number on the product information sheet. Cutsheets without specific product characteristics indicated will be rejected without review.
4. Exceptions to the above are at the discretion of the lighting designer/reviewer.

B. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.

1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
2. Include finishes for lighting poles and luminaire-supporting devices.
3. Anchor bolts.

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) 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 a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles 50 feet high or less is [100 mph] [90 mph] <Insert value from AASHTO LTS-6-M for this Project>.

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factor: 1.0.

B. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

C. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

A. Manufacturers: Subject to compliance with requirements, provide products as specified on the drawings.

B. Source Limitations: Obtain poles from single manufacturer or producer.

C. Steel Mast Arms: Type as specified on drawings, continuously welded to pole attachment plate. Material and finish same as plate.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

I. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder Coat: Comply with AAMA 2604.

    a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    b. Color: As selected by Architect from manufacturer's full range.

2.3 ALUMINUM POLES

A. Manufacturers: Subject to compliance with requirements, provide products as specified on the drawings.

B. Source Limitations: Obtain poles from single manufacturer or producer.

C. Mast Arms: Type as specified on drawings, continuously welded to pole attachment plate. Material and finish same as plate.

D. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

F. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "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.

G. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

J. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.

a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
b. Color: As selected by Architect from manufacturer's full range.

2.4 POLE ACCESSORIES

A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 26 27 26 "Wiring Devices."

1. Recessed 24 inches below bottom of fixture head.

a. NEMA 250, Type 3R, nonmetallic polycarbonate plastic or reinforced fiberglass, enclosure with cover; color to match pole.
b. Lockable hasp and latch complying with OSHA lockout and tag-out requirements.

B. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

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

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. 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, luminaire, and accessories.

1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.

C. Direct-Buried Foundations: Install to depth indicated on Drawings, but not less than as indicated. Add backfill in 6-inch to 9-inch layers, tamping each layer before adding the next. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.

D. Anchor Bolts: Install plumb using manufacturer-supplied plywood template, uniformly spaced.

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches.
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
3. Trees: 15 feet from tree trunk.

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 Section 03 30 00 "Cast-in-Place Concrete."

D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 05 26 "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 luminaire to grounding system.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.
2. System function tests.

END OF SECTION

SECTION 26 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

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

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. 3M Fire Protection Products.
2. Hilti, Inc.
3. Nelson Thermal, Inc.
4. RectorSeal.
5. Specified Technologies, Inc.
6. Tremco, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

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

2.3 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg. Select ratings below based on application.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg. Select ratings below based on application.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg. Select ratings below based on application.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.4 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

D. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

E. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

F. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Firestopping method for all penetrations containing low-voltage and control cabling shall allow for easy addition or replacement of cabling in future. Sealing sleeves or openings with single-use sealant is not acceptable.

3.4 IDENTIFICATION

A. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Permit number.
5. Date of installation.
6. Manufacturer's name.
7. Installer's name.

B. Identification label shall be minimum 2 inches by 4 inches, silver in color, with indelible printing.

3.5 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM APPROVAL

1. Provide UL-classified systems. Refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

END OF SECTION

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Selection and installation of communications busbars.
2. Selection and installation of communications bonding conductors.

B. Related Requirements:

1. Section 27 00 10 "Supplemental Requirements for Communications" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.3 DEFINITIONS

A. BBC: Backbone bonding conductor, for connecting multiple TBBs serving the same floor.

B. PBB: Primary bonding busbar, located in main distribution frame room, ideally near electrical service entrance.

1. PBB is also referenced as TMGB (Telecommunications main grounding busbar).

C. RBB: Rack bonding busbar, located in equipment cabinets and racks.

D. RBC: Rack bonding conductor, for connection RBBs to TEBCs in large multi-rack telecom rooms

E. SBB: Secondary bonding busbar, located in intermediate distribution frame rooms.

1. SBB is also referenced as TGB (Telecommunications grounding busbar).

F. SBC: Secondary bonding conductor, for connecting SBBs to TBBs in multi-story large buildings.

G. TBB: Telecommunications bonding backbone, for connecting SBBs to PBB.

H. TBC: Telecommunications bonding conductor, for connecting PBB to intersystem bonding termination device or busbar at electrical service entrance.

I. TEBC: Telecommunications equipment bonding conductor, for connecting RBBs to SBBs or PBB.

J. UBC: Unit bonding conductor, for connecting individual communications equipment to RBBs or SBBs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. For communications equipment room signal reference grid.
2. Include plans, elevations, sections, details, and attachments to other work.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installing wire connector on conductor.
2. Recommended torque values.

1.6 CLOSEOUT SUBMITTALS

A. Record Documentation: Project record documents in accordance with Section 01 78 39 "Project Record Documents" must include:

1. Locations of PBB and SBBs
2. Routing of TBC, TBBs, SBCs, and BBCs
3. Locations of ground rods, test wells, ground rings, and roof rings

B. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

C. Test Results:

1. Ground-resistance test, measured at the point of TBC connection.
2. Bonding-resistance test at each PBB or SBB and its nearest grounding electrode.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of ITS Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of TBC connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of TBC only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF COMMUNICATIONS BUSBARS

A. Unless otherwise indicated in this Section or on Drawings, provide products by the same manufacturer specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems" for the CGEB and GEB.

B. Comply with TIA-607-D.

3.3 SELECTION OF COMMUNICATIONS BONDING CONDUCTORS

A. Unless otherwise indicated in this Section or on Drawings, provide products specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Comply with TIA-607-D.

C. Communications Busbar Connections:

1. TBB: Not smaller than 2 kcmil per linear ft of conductor length, but not smaller than 6 AWG and not larger than 750 kcmil, unless otherwise indicated on Drawings.
2. TBC: Not smaller than largest TBB unless otherwise indicated on Drawings.
3. BBC: Not smaller than largest TBB to which it is connected unless otherwise indicated on Drawings.
4. SBC: Not smaller than 6 AWG and not smaller than the largest conductor bonded to the associated SBB, unless otherwise indicated on Drawings.
5. TEBC: Not smaller than 6 AWG and not smaller than the largest equipment grounding conductor serving the rack/cabinet, unless otherwise indicated on Drawings. Provide bolted connectors.
6. UBC: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted connectors.

7. Bonding Conductors to Structural Steel: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted clamp connectors.

3.4 INSTALLATION OF BONDING FOR COMMUNICATIONS

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Bonding of Communications: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with BICSI N3.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Busbars:

a. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 12 inch above finished floor unless otherwise indicated.
b. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

2. Conductors:

a. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
b. Assemble wire connector to conductor, complying with manufacturer's published instructions and as follows:

1) Use crimping tool and die specific to connector.
2) Pretwist conductor.
3) Apply antioxidant compound to bolted and compression connections.

c. Install in straightest and shortest route between origination and termination point, and no longer than required. Bend radius must not be smaller than 10 times diameter of conductor. No single bend may exceed 90 degrees.
d. Install without splices.
e. Support conductors at not more than 36 inch intervals.
f. Outside telecommunications rooms, install conductors in metric designator 21 (trade size 3/4) PVC-80 conduit until conduit enters telecommunications room. Install bonding conductors in EMT-A or EMT-SS when routed through plenum. Do not install bonding conductors in EMT-S unless otherwise indicated on Drawings.

1) If bonding conductor must be installed in EMT-S or other ferrous metallic raceway, bond conductor to raceway using grounding bushing that complies with Section 27 05 28 "Pathways for Communications Systems," and bond both ends of raceway to SBB.

3. Provide TBC and terminate ends to PBB and intersystem bonding termination device at electrical service entrance in accordance with Section 250.94, "Bonding for Communication Systems," of NFPA 70.
4. Structural Steel: Where structural steel of steel frame building is readily accessible within room or space, bond each PBB to vertical steel of building frame.

5. Communications Enclosures: Bond metallic enclosures of telecommunications equipment with UBCs to nearest PBB.
6. Equipment Racks: Bond metallic components of enclosures to RBB using UBCs. Provide top-mounted RBB if not provided by enclosure or rack manufacturer. Bond RBB to SBB with TEBC. Power connection must comply with NFPA 70; equipment grounding conductor in power cord of cord- and plug-connected equipment must be considered supplemental to bonding requirements in this Section.
7. Primary Protector: Bond to PBB with insulated bonding conductor.
8. Electrical Power Panelboards: Where electrical panelboards for communications equipment are located in same room or space, bond each ground bar of panelboard to SBB.
9. Insert connections for other equipment.

3.5 IDENTIFICATION

A. Comply with Section 27 05 53 "Identification for Communications Systems."

B. Labels must be preprinted or computer-printed type.

1. Label PBBs with "ts-PBB," where "ts" is telecommunications space identifier for location of PBB.
2. Label SBBs with "ts-SBB," where "ts" is telecommunications space identifier for location of SBB.
3. Provide warning sign at each PBB or SBB with legend: "IF A CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL "
4. Label TBC, TBBs, and BBCs at attachment points with legend: "WARNING! COMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.6 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Architect.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench according to manufacturer's published instructions.
2. Test bonding connections of system using AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing PBB or SBB, using process recommended by BICSI N1. Conduct tests with facility in operation.

    a. Measure resistance between PBB and electrical service intersystem termination point. Maximum acceptable value is 100 mΩ.

        1) If measured resistance from electrical service equipment to ground exceeds the value specified in Section 26 05 26, notify Architect and include recommendations to reduce resistance to ground.

    b. Measure resistance between SBBs and PBB. Maximum acceptable value is 100 mΩ.

3. Test for ground loop currents using digital clamp-on ammeter, with full scale not more than 10 A, displaying current in increments of 0.01 A at accuracy of plus or minus 2.0 percent.

    a. With grounding infrastructure completed and communications system electronics operating, measure current in bonding conductors connected to PBB. Maximum acceptable AC current level is 1 A.

C. Nonconforming Work:

1. Communications bonding will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.

3.7 PROTECTION

A. After installation, protect busbars and conductors from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Optical-fiber Cabling Pathways (Innerduct).
2. Hooks.
3. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for general box requirements, as well as specifications for enclosures, cabinets, junction boxes, pull boxes, and underground enclosures.
2. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 ACTION SUBMITTALS

A. Product data for the following: For cabling pathways, hooks, and communications outlet boxes.

1.4 UNIT PRICE

A. Include on Bid Form a unit price for furnishing and installing a data outlet box. A data outlet box shall consist of a two gang outlet box, double gang plaster ring, blank wall plate and conduit stubbed up concealed in wall and turned out above accessible ceiling. Unit price shall reflect an outlet installed during the normal course of installation.

1.5 COORDINATION

A. Provide all pathways, raceways, and boxes for communications cabling systems.

B. Owner, through Architect, reserves the right to move any outlet or stubbed-up conduit, a distance of twenty-five feet before roughing-in, without additional cost to Owner.

C. Backbone cabling, hardware and connecting blocks, to be provided under separate contract. Coordinate pathway installation with Owner before rough-in.

D. All electronics, active networking hardware, and end-user devices (telephones, computers, monitors, etc) to be furnished and installed by Owner.

E. Contact the Owner's telecommunications network representative for specific instructions prior to beginning work.

1. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
2. All materials shall be provided and installation shall be completed in accordance with Owner's latest telecommunication standards.

PART 2 - PRODUCTS

2.1 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS (INNERDUCT)

A. Description: Comply with UL 2024; flexible-type corrugated pathway with a circular cross section, approved for riser installation unless otherwise indicated.

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

1. Anixter, Inc.
2. Carlon; a brand of Thomas & Betts Corporation.
3. Dura-Line.
4. Endot Industries Inc.
5. IPEX USA LLC.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.2 HOOKS

A. Description: Prefabricated sheet metal cable supports, designed for supporting category-rated and fiber optic telecommunications cable.

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

1. MonoSystems, Inc.
2. nVent Erico.
3. Panduit Corp.
4. Wiremold / Legrand.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Construction:

1. Galvanized steel.
2. J shape, wide base.

F. Provide mounting hardware as required by mounting location and surface.

G. Provide brackets for ganging multiple hooks at a single location where required.

2.3 COMMUNICATIONS OUTLET BOXES

A. Description: Outlet boxes for communications.

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

1. Arlington Industries, Inc.
2. Crouse-Hinds, an Eaton business.
3. EGS/Appleton Electric.
4. Hubbell Incorporated.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. RACO; Hubbell.
7. Thomas & Betts Corporation; A Member of the ABB Group.
8. Wiremold / Legrand.

C. General Requirements for Communications Outlet Boxes:

1. Comply with TIA-569-E.
2. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

D. Refer to Section 26 05 33 "Raceways and Boxes for Electrical Systems" for general box types and requirements.

E. Type: Standard Recessed Telecommunications Box.

1. Dimensions: 4 11/16-inch by 4 11/16-inch square, 2 1/8-inch depth.
2. Galvanized steel construction.
3. Single- or double-gang ring as required by outlet type.
4. Provide with plaster rings where installed in plaster finish areas and to accommodate wall/ceiling depth.
5. Provide with masonry rings where installed in masonry construction.
6. Provide with tile bridge where installed recessed in ceiling.

F. Type: Standard Surface Telecommunications Box.

1. Copper-free aluminum or rust-resisting alloy construction.
2. Threaded hubs compatible with applicable conduit.
3. Gasketed, watertight cover with stainless steel fasteners for exterior applications.

G. Type: Recessed Combination Power/Telecommunications Box.

1. Basis of Design: Hubbell HBL 260 Series.
2. Dimensions: 4 11/16-inch by 4 11/16-inch square, 3 1/4-inch depth.
3. 66.7 cubic inch capacity.

4. Galvanized steel construction.
5. Concentric knockouts from 1/2-inch to 2-inch.
6. Low voltage partition to separate power and low voltage wiring.
7. Provide with single- or two-gang plaster ring as indicated on drawings, ring depth as required by wall finish.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Refer to Section 26 05 33 "Raceways and Boxes for Electrical Systems" for application schedule for raceways.

3.2 PATHWAY INSTALLATION

A. General Requirements:

1. Refer to Section 26 05 33 "Raceways and Boxes for Electrical Systems" for installation guidelines for raceways.
2. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
3. Comply with installation requirements in Section 27 15 13 "Communications Copper Horizontal Cabling".

B. Additional Requirements: Comply with the following requirements for communications pathways in addition to the requirements found in the sections listed above.

1. Comply with the following standards for installation requirements for communications pathways:

    a. NECA/BICSI 568.
    b. TIA-569-D.
2. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
3. Stub-outs to Above Recessed Ceilings:

    a. Provide minimum one 1-inch conduit, unless noted otherwise, up from each communications outlet box concealed in wall and stub-out above accessible ceiling.
    b. Use a conduit bushing or insulated fitting to terminate stub-outs not terminated in hubs or in an enclosure.

4. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets.
5. Install insulated bushings on conduits terminated with locknuts.
6. Install all supports and hardware required to attach communications pathways to building structure. Communications pathways shall not be attached to or supported from conduits, boxes, piping, ceiling support systems, or the work of other trades. Install cabling in pathways, do not support cabling directly from building structure.
7. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

C. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

D. Optical-Fiber Cable Pathway (Innerduct) Installation:
1. Install all interior fiber optic cabling in innerduct to within 12 inches of termination enclosure.Install all exterior fiber optic cabling in innerduct. Provide one 1 1/4-inch and two 1-inchinnerduct in each 4-inchconduit, unless noted otherwise.
2. Install pull string in all innerduct.

E. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 4 feet o.c.
5. Provide a hook at each change in direction.
6. Do not install more than 50 cables per hook.
7. Provide additional hooks for all pathways consisting of more than 40 communications cables.
8. Cabling shall be bundled according to purpose. Provide separate hook for data and voice cabling from other communications cabling. Non-category-rated communications cabling shall be installed in separate hooks from category-rated commuications cabling.

F. Mounting Heights:

1. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
2. Coordinate location and mounting heights of all outlets with Architect and Owner before rough-in.
3. Height of communication outlet boxes shall be as follows, unless noted otherwise on drawings:

    a. Standard Data and Telephone Outlets: 18 inches above finished floor.
    b. Standard Data and Telephone Outlets, Mounted Above Counter: 6 inches above counter backsplash, unless noted otherwise. Coordinate height with Architectural elevations before rough-in.
    c. Wireless Access Point Outlets: Install above ceiling at location shown for accessible ceiling areas, install flush recessed in ceiling for non-accessible ceiling locations.
    d. Equipment Outlets: Coordinate location and mounting height with contractor responsible for supplying and installing equipment.

e. Wall-Hung Monitors, Televisions, and Projectors: As indicated on drawings.
f. Other System Outlets: As indicated on drawings.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

3.4 Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Boxes." FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 26 84 13 "Penetration Firestopping".

END OF SECTION

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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. Boxes, enclosures, and cabinets.
2. Power strips.

B. Related Requirements:

1. Section 27 15 13 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. PBB: Primary Bonding Busbar (formerly TMGB)

D. RBB: Rack Bonding Busbar

E. RCDD: Registered Communications Distribution Designer.

F. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

G. SBB: Secondary Bonding Busbar (formerly TGB)

1.4 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 equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
2. Installation Supervision: Installation shall be under direct supervision of Installer 2, Copper or Fiber, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform on-site inspection.

PART 2 - PRODUCTS

2.1 BOXES, ENCLOSURES, AND CABINETS

A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems".

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

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

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

F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

G. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

2.2 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting, with detachable flanges.
3. Height: [1 RU]. .
4. Housing: Metal.
5. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
6. LED indicator lights for power and protection status.
7. LED indicator lights for reverse polarity and open outlet ground.
8. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
9. Cord connected with 15-foot line cord.
10. Rocker-type on-off switch, illuminated when in on position.
11. Surge Protection: UL 1449, Type 3.

a. Maximum Surge Current, Line to Neutral: 72 kA.

b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V and 500 V. for neutral to ground.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Comply with requirements in Section 27 05 28 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.

1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Comply with requirements in Section 26 84 13 "Penetration Firestopping".

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION

SECTION 27 11 16 - COMMUNICATIONS RACKS, FRAMES, 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.

1.2 SUMMARY

A. Section Includes:

1. 19-inch equipment cabinets.
2. Power strips.
3. Grounding.
4. Labeling.

B. Related Requirements:

1. Section 27 11 10 "Communications Equipment Room Fittings" for backboards and accessories.
2. Section 27 05 26 "Grounding and Bonding for Telecommunications Equipment" for PBBs and SBBs.
3. Section 27 15 13 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. LAN: Local Area Network.

D. PBB: Primary Bonding Busbar (formerly TMGB).

E. RBB: Rack Bonding Busbar.

F. RCDD: Registered Communications Distribution Designer.

G. SBB: Secondary Bonding Busbar (formerly TGB).

H. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

1.4 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 equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.

B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of PBB or SBB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
2. Installation Supervision: Installation shall be under direct supervision of Installer 2, Copper or Fiber, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform on-site inspection.
4. Installer shall be certified by Owner as an approved data equipment installer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. UL listed.

B. RoHS compliant.

C. Compliant with requirements of the Payment Card Industry Data Security Standard.

2.2 19-INCH EQUIPMENT CABINETS

A. Equipment cabinet frames, doors and covers will be furnished by Owner, installed by General Contractor. Internal components including patch panels, fiber termination racks and shelves shall be furnished by Owner and installed by Electrical Contractor. Provide one (1) power strip and one (1) grounding strip in each cabinet.

2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Cord connected with 15-foot line cord.
8. Rocker-type on-off switch, illuminated when in on position.
9. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.4 GROUNDING

A. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

2.5 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate final rack layouts with fiber termination enclosures, patch panels, wire management panels and equipment to be furnished by the Owner prior to installation.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

1. Mount receptacles inside cabinet.

3.2 GROUNDING

A. Comply with NECA/BICSI 607.

B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.

3.3 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 27 05 53 "Identification for Electrical Systems."

B. Comply with requirements in Section 09 91 23 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration[, including optional identification requirements of this standard].

D. Labels shall be machine printed.

END OF SECTION

SECTION 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including connecting blocks, patch panels, plugs and jacks.

B. Related Requirements:

1. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also commonly called an "outlet," it is the fixed, female telecommunications connector.

I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

O. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Telecommunications conductor drop locations.
    f. Typical telecommunications details.

C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Contractor shall be recognized by the manufacturer providing the cable system performance warranty as an approved/certified installer of their product. Furnish a certificate from the manufacturer with the shop drawings.
2. Contractor shall submit with shop drawings a list of the project team which shall include, as a minimum, the project manager and foreman. Note on the list the personnel that have been trained and certified by the data system manufacturer along with a brief description of their experience and training. Changes to project staffing after contract award must be requested, in writing, and approved by Owner prior to any changes.
3. Where applicable, contractor shall have personnel trained and certified in category rated UTP and fiber optic cable installation, termination and testing techniques. Personnel shall have experience using a category rated cable tester, fiber optic light meter and power source and OTDR.

B. Layout Responsibility: Preparation of Shop Drawings by an RCDD.

C. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and 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.

1.11 COORDINATION

A. Furnish, install, connect, and test all items specified in this section.

B. Provide all pathways, raceways, and boxes for horizontal cabling systems.

C. Owner, through Architect, reserves the right to move any outlet or stubbed-up conduit, a distance of twenty-five feet before roughing-in, without additional cost to Owner.

D. All electronics, active networking hardware, and end-user devices (telephones, computers, monitors, etc) to be furnished and installed by Owner.

E. Contact the Owner's telecommunications network representative for specific instructions prior to beginning work.

1. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

F. All materials shall be provided and installation shall be completed in accordance with Owner's latest telecommunication standards.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-D-1.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Non-plenum: Type CMR complying with UL 1666.

B. All cable shall be riser rated, unless noted otherwise.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

D. RoHS compliant.

E. Unless otherwise noted, all cabling shall utilize solid conductors.

2.3 ACCEPTABLE MANUFACTURER

A. All horizontal distribution cabling used on project shall be of the same manufacturer.

B. Manufacturers: Subject to compliance with requirements, provide cabling by one of the following:

1. Belden CDT Networking Division/NORDX.
2. Berk-Tek Leviton; a Nexans/Leviton alliance.
3. General Cable; General Cable Corporation.
4. Hitachi Cable America Inc.
5. Hubbell Premise Wiring.
6. Mohawk; a division of Belden Networking, Inc.
7. Superior Essex Inc.

2.4 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Cable performance shall exceed TIA and ISO Category 6 standard levels by 3 dB in NEXT, PSNEXT, ACR, PSACR, ELFEXT, and PSELFEXT.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP).

2.5 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

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

1. 3M.
2. Belden CDT Networking Division/NORDX.
3. Berk-Tek Leviton; a Nexans/Leviton alliance.
4. CommScope, Inc.
5. General Cable; General Cable Corporation.
6. Hubbell Premise Wiring.
7. Leviton Manufacturing Co., Inc.
8. Mohawk; a division of Belden Networking, Inc.
9. Panduit Corp.
10. Siemon Co. (The).
11. Superior Essex Inc.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Connecting Blocks:

1. Type:

a. 110-style IDC for Category 6.
2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
3. Mounting: Rack-mounted.
4. Furnish all connecting blocks with labels and label holders.
5. Furnish protective covers, color coded to match cabling.

E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables. Jacks are mounted in an angled panel to increase capacity of the rack.

1. Basis of Design: Leviton 69587 series.
2. Features:

a. Universal T568A and T568B wiring cards for 110-style terminations.
b. Color-coded front labeling for easy port identification (ANSI/TIA-606-B compliant).
c. Capable of multiple re-terminations.
d. 48 ports mounted in a plate with a 128-degree angled design.

3. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
4. Number of Jacks per Field: One for each four-pair cable indicated.
5. Bandwidth: Shall exceed usable bandwidth for associated cabling.
6. Shall exceed IEEE 802.3bt standard up to 0.5 amps per conductor (100 watts) continuously for Type 4 POE applications.

G. Patch Cords: Factory-made, four-pair cables in 72-inch (1800-mm) lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Provide patch cords to connect patch panels to network equipment in each telecommunications space. Furnish one patch cored for 100 percent of voice and data outlets installed in project, plus 2 percent (minimum 10) spare.
3. Color: To match associated system cable color.

H. Equipment Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.

1. Equipment cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Provide equipment cords to connect outlets to equipment and devices (wireless access points, building automation system, fire alarm system, security system, etc.). Furnish one equipment cord for each equipment outlet installed in project.
3. Color: To match associated system cable color.

I. Jacks and Jack Assemblies:

1. Basis of Design: Hubbell NextSpeed Series.
2. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
3. Designed to snap-in to a patch panel or faceplate.
4. Standard: Comply with TIA-568-C.2.
5. Accomodates T568A and T568B wiring.

J. Faceplates:

1. Rear-Loading, Flush-Mounted Faceplate:

a. Basis of Design: Hubbell IFP Series.
b. Type: Rear-loading, flush-mount for modular jacks and inserts.
c. Configuration: Four port, vertical single gang faceplates designed to mount to single gang wall boxes.
d. Quantity and configuration of jacks as indicated on drawings.
e. Plastic Faceplate: High-impact plastic. Coordinate color with Section 26 27 26 "Wiring Devices."
f. Metal Faceplate: Stainless steel, complying with requirements in Section 26 27 26 "Wiring Devices."
g. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
h. Label insets with label covers, provide labels on all faceplates.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 GROUNDING

A. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-D-1.

2.8 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA-568-C.1.

B. Factory test twisted pair cables according to TIA-568-C.2.

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

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways, except above accessible ceilings and within cabinets, furniture partitions, and desks where unenclosed wiring method may be used.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Provide minimum 1 inch conduit up from each outlet box, concealed in wall, and turn out above accessible ceiling.
3. Install cables in raceway above all non-accessible ceiling areas.
4. Comply with requirements for raceways and boxes specified in Section 27 05 28 "Pathways for Communications Systems."
5. Provide conduit sleeves as required for all cables in accordance with Section 27 05 44 "Sleeves and Sleeve Seals for Communications Pathways and Cabling".

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with Section 27 11 00 "Communications Equipment Room Fittings."

B. Comply with Section 27 05 28 "Pathways for Communications Systems."

C. Drawings indicate general arrangement of pathways and fittings.

D. Comply with NFPA 70 for pull-box sizing and length of conduit and number of bends between pull points.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF HARDWARE

A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 27 11 00 "Communications Equipment Room Fittings."

B. All termination hardware shall be installed in accordance with manufacturer's recommended procedures and methods.

C. All hardware shall be placed so as to make efficient use of available space in coordination with other uses. All wiring and associated hardware shall be placed so as to not impair the use or capacity of other building systems, equipment, or hardware placed by others (or existing).

D. Color of all patch panel ports and jacks shall match color of associated system cabling.

E. Faceplates:

1. Provide blank inserts in all unused ports.
2. Install all faceplates level and plumb.

3.4 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. 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.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
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 Information Transport Systems Installation Methods Manual , Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Cables shall be bundled with removable hook-and-loop fasteners, nylon tie-wraps are not acceptable.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
13. Slack:

    a. In each outlet box, provide 12 inches of coiled slack cable.
    b. At outlet locations, provide 6 feet of slack stored at the last cable support.
    c. At wireless access point outlets installed above accessible ceiling, provide 20 feet of slack stored at the outlet.

C. System Color for Building Cables:

1. Voice: Blue.
2. Data: Blue.
3. Wireless Access Points: Purple.
4. Lighting Control: Green.
5. Security/Access Control: White.
6. CCTV: White.
7. Other systems as applicable

D. System Color for Jacks:

1. Jacks: Gray.

E. System Color for Patch Cables:

1. Patch Cables: Same as System Color for Building Cables.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper 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, 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 Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRESTOPPING

A. Comply with requirements in Section 26 84 13 "Penetration Firestopping".

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.6 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-D-1 and NECA/BICSI-607.

C. Bond metallic equipment to the Primary or Secondary Bonding Busbar (PBB or SBB), using not smaller than a No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 27 05 53 "Identification for Communications Systems."

1. Administration Class: Class 3.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

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

B. Cables and termination hardware shall be 100 percent tested for defects in installation and to verify cable performance under installed conditions. All conductors of each installed cable shall be verified usable by the contractor prior to system acceptance. Any defect in the cable system installation including but not limited to cable, connectors, feed through coupler, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100 percent usable conductors in all cables installed.

C. Tests and Inspections:

1. Every cabling link in the installation shall be tested in accordance with the field test specifications defined in the most recent standard of the Telecommunications Industry Associations (TIA)/Electronics Industry Association (EIA).
2. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test twisted pair 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.
5. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION

SECTION 28 15 00 - ACCESS CONTROL 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.

B. This work shall be done in strict accordance with these Contract Documents prepared for The Pennsylvania State University, hereafter referred to as "Owner".

C. The Contractor shall perform all work described in this document along with any work not expressly mentioned in the specifications, but obviously necessary for the proper execution of the same. It is not the intent to delineate or describe every detail and feature of work. No additions to the contract sum will be approved for any materials, equipment, and/or labor to perform work hereunder unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications and absolutely essential to the proper prosecution of the work.

D. Work under this contract consists of the complete installation and includes, but is not necessarily limited to, the furnishing of all labor, superintendence, material, tools, and equipment necessary to complete all the work as specified herein.

1.2 SUMMARY

A. Section Includes:

1. Access Control System Components
2. Cables
3. Transformers

B. Related Requirements:

1. Door Details: Refer to Contract Documents.

C. Owner Requirements:

1. Furnish, install, and program a functionally complete integrated access control, electronic locking, and door monitoring system per Manufacturer's guidelines and codes, as described in these specifications.
2. Equipment and application shall comply with PSU Policy AD-65.

1.3 DEFINITIONS

A. Credential: Data assigned to an entity and used to identify that entity.

B. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.

C. Identifier: A credential card; 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.

D. 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 a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.

E. PC: Personal computer. Applies to the central station, workstations, and file servers.

F. RAS: Remote access services.

G. RF: Radio frequency.

H. ROM: Read-only memory. ROM data are maintained through losses of power.

I. TCP/IP: Transport control protocol/Internet protocol.

J. 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.

K. WMP: Windows media player.

L. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

M. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

1.4 ACTION SUBMITTALS

A. Product Data: Specification sheet for each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings.

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

1. Diagrams for cable management system.
2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:

    a. Workstation outlets, jacks, and jack assemblies.
    b. Patch cords.
    c. Patch panels.

4. Cable Administration Drawings: As specified in "Identification" Article.
5. Battery and charger calculations for central station, workstations, and controllers.

C. Product Schedules: Identify model number, quantity, and unit cost of each device.

D. Permits: Identify requirements for permits from all building, police, and fire authorities for the installation of the specified system(s). Assist the Owner in obtaining the required permits.

E. Specification Compliance: Provide a letter with the bid indicating compliance with the specifications, referencing each sub-section individually. List any exceptions, substitutions, or alternatives to each sub-section as appropriate. Requests for substitutions shall be submitted to the Engineer, along with all relevant technical data pertaining to substituted equipment, ten (10) days prior to the close of bid for evaluation and approval.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on USB media of the hard-copy submittal.
2. System installation and setup guides with data forms to plan and record options and setup decisions.

B. As-Built Drawings: PDF files generated from either AutoCAD or Revit of each floor plan.

1. Indicate exact device locations, panel terminations, cable routes, and wire numbers as tagged and color-coded on the cable tag.
2. Provide final point-to-point wiring diagrams of each type of device.
3. Provide to Owner for approval prior to final system acceptance walk through.

C. Hard copies of the following shall be placed in each iSTAR panel installed on this project:

1. iSTAR installation manual.
2. Reader and reader interface manual(s).
3. Door release hardware manual(s).
4. Request to exit motion detector manual(s).
5. Power supply manual(s).
6. All wiring notes.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Cable installer must have on staff an RCDD certified by Building Industry Consulting Service International.
2. Contractor shall be a factory-authorized and trained dealer of the system and shall be certified to maintain and repair the system after system acceptance.

B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer. Manufacturer shall have been in business manufacturing similar products for at least five (5) years.

C. All equipment, systems, and materials furnished and installed under this section shall be installed in accordance with the applicable standards of:

1. National Fire Protection Association (NFPA)
2. National Electric Code (NEC, NFPA 70)
3. Underwriters Laboratories (UL)
4. Pennsylvania Department of Labor and Industry (L&I)
5. EIA/TIA Telecommunications Wiring Standards
6. Local authorities having jurisdiction (AHJ)
7. The Pennsylvania State University (PSU)

D. All components, parts, and assemblies supplied by the Manufacturer and installed by the contractor shall be warranted against defects in material and workmanship for a period of at least twelve (12) months (parts and labor), commencing upon date of acceptance by Owner. A qualified factory-trained service representative shall provide warranty service.

1.8 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. 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.

C. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.

D. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.9 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. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

3. Outdoor Environment: NEMA 250, NEMA 250, Type 3R enclosures. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.

PART 2 - PRODUCTS

2.1 OPERATION

A. Security access system hardware shall use a single database for access-control and credential-creation functions.

2.2 PERFORMANCE REQUIREMENTS

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

B. Comply with NFPA 70, "National Electrical Code."

C. Comply with SIA DC-03.

2.3 ACCESS CONTROL SYSTEM

A. Description: The Pennsylvania State University has initiated a multi-phase access control project for the University Park and Commonwealth campuses. The system utilizes Tyco Software House CCure9000 software running on a CCure server. The hardware consists of Tyco Software House iSTAR Controller and associated hardware, which provides for the physical connection to readers, locking hardware, door status switches, and request to exit devices.

Software House iSTAR has been approved as a Proprietary Item and substitutions will not be permitted without permission of Owner.

B. Software House iSTAR System Feature/Capability: The following indicates system capabilities and capacities:

1. LAN/WAN Communications: CCure host server to local iSTAR panel.
2. The iSTAR panels shall have a minimum of 64MB RAM to exceed the University requirement of 10,000 card records and 3,000 event storage capabilities to retain event information in the case of network failure.
3. Programming Software: The programming software shall include the following features:

    a. LAN/WAN connection with CCure Host
    b. Fully configurable user authority level control
    c. CCure parameter editing and storage
    d. CCure and iSTAR software upgrade ability
    e. LAN/WAN Communications database management
    f. Event history buffer uploading

C. Software House iSTAR System Interface Requirements

1. All Installations: The Software House iSTAR access control system shall be installed in accordance with the National Electric Code and the local Authority Having Jurisdiction (AHJ).
2. The Software House iSTAR access control hardware shall be installed in accordance with UL requirements.

2.4 SYSTEM MATERIALS

A. System Hardware Description

1. iSTAR System: The access control system shall be provided, at a minimum, with the following components. Additional accessories shall be provided based on the quantities and features required for the application.

a. Tyco Software House iSTAR panel.

1) System Accessories:

a) 64 MB RAM or greater
b) iSTAR power supply with 7 amp hour battery backup for panel and door strikes

b. HID Signo series card readers
c. Software House RM-4 reader module
d. Von Duprin PS873 power supplies for electric latch retraction activation
e. Von Duprin exit hardware mounted request-to-exit switches
f. Von Duprin electric latch retraction solenoids
g. Von Duprin 6000 Series electric door strikes
h. Interlogix 1078C door status monitor switches
i. Bosch Security Systems DS160 request-to-exit motion detectors with integral sounders
j. System Sensor PA400 Series door ajar sounders
k. Tripp-Lite Model# IBAR4 or an approved equivalent surge suppressor
l. Handicapped door opener interfaces
m. Altronix AL400ULACMCB or equivalent power supply
n. Von Duprin EPT-10 power transfer device

2.5 TYCO SOFTWARE HOUSE iSTAR (ADVANCED PROCESSING CONTROLLER)

A. iSTAR Advanced Processing Controller Description: The iSTAR specified herein shall be used to control the locking/unlocking of doors.

B. iSTAR Feature/Capability Summary: The following indicates the iSTAR capabilities, capacities, and formats:

1. Advanced Processing Controller (iSTAR): The iSTAR shall include the following features:

a. Must have re-programmable FLASH memory for software upgrades and future product enhancements.
b. Must contain a 3,000 Event history buffer (minimum)

c. Must support 50,000 or greater card holders
d. Possess the capability of 255 time commands for automatic input, output, and reader mode control
e. Must have the ability of elevator control
f. Must possess real-time full-year clock and calendar
g. Must retain up to 80 hours of memory retention in the event of extended power failure

2. Inputs and Outputs: The Inputs and Outputs shall include the following features:

a. Thirty-two supervised and programmable inputs
b. Sixteen programmable Form C SPDT dry contacts rated at 2.5 amps @ 30V AC/DC outputs for reader controlled unlocking of doors

C. iSTAR System Interface Requirements

1. Grounding: Properly ground the iSTAR panel to prevent electrostatic charges and other transient electrical surges from damaging the panel.
2. Primary power: Connect the iSTAR panel to a dedicated 120 VAC power source through the external power supply.
3. Power supervision: The external power supply shall provide contacts that activate when there is an AC power failure and the system will report a "Power Failure" message to the CCure server.
4. Communications: Connect the iSTAR to the MSS485 terminal server for communications and programming with the CCure host server.
5. Housing: Install the iSTAR in a 16 AWG metal wall mounted lockable cabinet with tamper switches on the front and rear. (Standard Software House Cabinet).

2.6 HID GLOBAL SIGNO 20 CARD READER [CR]

A. Signo 20 Card Reader Description: The card reader specified herein shall be used to read Pennsylvania State University smart cards for the purpose of providing access control to secured areas of the University Park campus.

1. Signo 20 Feature/Capability Summary: The following indicates reader capabilities and formats:

a. 13.56 MHz (NFC) credentials via MIFARE DESFire EV1/EV2
b. Typical read range for MIFARE DESFire EV1/EV2: 1.6 to 4 inches.
c. Mounting: Mullion-mount door installation or any flat surface.
d. Color: Black bezel with silver trim baseplate.
e. Dimensions: 1.77 inches by 4.78 inches by 0.77 inches.
f. Operating Voltage: 12 volts DC.
g. Environmental Rating: UL294 Outdoor and Indoor rated, IP65.
h. Transmit Frequency: 125 kHz, 12.56 MHz (NFC), 2.4 GHz (Bluetooth).
i. Certifications (US): UL294/cUL, FCC.
j. Housing: Polycarbonate, UL94 V0.
k. Warranty: Limited Lifetime.

2.7 ALTRONIX MAXIM3D POWER SUPPLY [DPS]

A. Altronix Power Supply Description: The MAXIM3D distributes and routes power to access control systems and accessories. It will convert an 115VAC 50/60Hz input into eight (8) independently controlled PTC protected class 2 power limited 12VDC or 24VDC outputs. Outputs are activated by an open collector sink or normally open (NO) dry trigger input from an Access Control System, Card Reader, Keypad, Push Button, PIR, etc.

The unit will route power to a variety of access control hardware devices including: Magnetic Locks, Electric Strikes, Magnetic Door Holders, etc. Outputs will operate in both fail-safe and/or fail-secure modes.

The FACP Interface enables Emergency Egress, Alarm Monitoring, or may be used to trigger other auxiliary devices. The fire alarm disconnect function can be configured for the following modes: a) eight (8) outputs affected or b) four (4) outputs affected and four (4) outputs unaffected (50/50 mode).

B. Altronix Power Supply Features/Capability Summary:

1. 4 amp continuous supply current at 12 VDC or 24 VDC.
2. Eight (8) Access Control System trigger inputs.
3. Fire Alarm disconnect.
4. Automatic switchover to stand-by battery when AC fails.
5. Thermal and short-circuit protection with auto reset.
6. Battery failure and battery presence supervision.
7. AC failure supervision.

C. Altronix Power Supply Interface Requirements:

1. Primary Power: Connect the power supply to a non-switched, dedicated 120 VAC power source.
2. Power Supervision: Connect the power supply's supervisory outputs to the iSTAR panel.
3. Battery Back-up: Provide for a minimum 12 hours of back-up power in the event of primary power failure.

2.8 CABLES

A. General Cable Requirements: Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and as recommended by system manufacturer for integration requirement.

B. Paired, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum-foil/polypropylene-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket, white color.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

C. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket, white color.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

D. LAN Cabling:

1. Comply with requirements in Section 27 15 13 "Communications Copper Horizontal Cabling."

2.9 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 BUILDING SECURITY

A. Building security shall remain functional during installation. Doors and door locking shall remain operational. University Police must be notified if it is not possible to lock the doors at the end of each workday. Failure to comply will result in removal from the approved vendor list.

3.2 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.

3.3 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with TIA 606-B, "Administration Standard for Commercial Telecommunications Infrastructure."

C. Product Schedules: Obtain detailed product schedules from manufacturer of access-control system or develop product schedules to suit Project. Fill in all data available from Project plans and specifications and publish as Product Schedules for review and approval.

D. In meetings with Architect and Owner, present Product Schedules and review, adjust, and prepare final setup documents. Use approved, final Product Schedules to set up system software.

3.4 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Construction."

B. Install cables and wiring according to requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in all spaces. Conceal raceway and cables except in unfinished spaces.

D. Firestopping: All cables penetrating floors and fire-rated walls must be routed through a properly firestopped metallic sleeve or a rated firestopping device to maintain the fire rating of the floor or wall.

E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5e rating of components and optical fiber rating of components, and that ensure Category 6 and optical fiber performance of completed and linked signal paths, end to end.

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. Boxes above ceiling level in occupied areas of the building shall not be considered 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.

3.5 CABLE APPLICATION

A. Comply with TIA 569-D, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. TIA 485-A Cabling: Install at a maximum distance of 4000 ft. between terminations.

D. Card Readers and Keypads:

1. Install number of conductor pairs recommended by manufacturer for the functions specified.
2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft., and install No. 20 AWG wire if maximum distance is 500 ft..
3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.

4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

E. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 ft. between terminations.

F. Install minimum No. 18 AWG ac power wire from transformer to controller, with a maximum distance of 25 ft. between terminations.

3.6 GROUNDING

A. Comply with Section 27 05 26 "Grounding and Bonding for Communications Systems."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding 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.

3.7 INSTALLATION

A. Install card readers, keypads, push buttons, and biometric readers.

3.8 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Section 27 05 53 "Identification for Communications Systems" and with TIA 606-B.

B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement, as well as the University's standard naming conventions.

C. 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.

D. At completion, cable and asset management software shall reflect as-built conditions.

3.9 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

B. Complete the programming of all inputs, outputs, readers, events, doors, and control panels. Programming of the system shall include the following:

1. Programming system configuration parameters (hardware and software, door location/number, communication parameters)
2. Programming operational parameters such as unlocking/locking times, events, door shunt times, and communication failure/restore times.
3. Other programming tasks required by Owner. Coordinate these additional programming requirements directly with the Owner.

3.10 FIELD QUALITY CONTROL

A. Field Coordination: Prior to installation, coordinate installation work with Architect, General Contractor, Electrical Contractor, Door/Hardware Contractor, and any other contractors associated with the system.

B. Acceptance Test Plan Form: Provide an Acceptance Test Plan Form to the Owner prior to performing an acceptance walk through. Include on the form separate sections for each device, panel, and unit, as well as a column indicating the manufacturer's performance allowance/margin, a column indicating the result of the testing performed by the Contractor (pass/fail), and an empty column for recording findings during the walk through.

C. 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.
2. Certify completion in writing and schedule a commissioning walk-through. Provide all tools and personnel needed to conduct an efficient commissioning process.

D. Tests and Inspections:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use tester approved for type and kind of installed cable. Test for faulty connectors, splices, and terminations. Test according to TIA 568-C.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for balanced twisted-pair cables must comply with minimum criteria in TIA 568-C.1.

2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

E. Devices and circuits will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports. Provide a hard copy system printout of all components tested. Certify 100 percent operation indicating all devices, panels, units, and other components have passed the test criteria set forth by the manufacturer.

G. Maintain updated drawings at the site and markup any changes to the location of devices or routing of cabling caused by field conditions, bulletins, or as otherwise directed by the Architect. At the completion of the project, provide a final set of markup drawings to the Architect for the creation of "as-built" drawings.

3.11 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Section 01 79 00 "Demonstration and Training."

B. Provide up to three (3) hours of on-site training, including:

1. Training on the proper installation and programming of all related hardware and software.
2. Training of departmental end-users.

C. 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.
5. Campus management.

3.13 WARRANTY SERVICE

A. Contractor shall be responsible for maintenance and repair of the system during the warranty period, free of charge (parts and labor), including repair of defects in workmanship.

B. Contractor shall correct any system defect within six (6) hours of receipt of call from Owner.

C. Contractor shall offer extended service/maintenance agreements up to four (4) years after the warranty expires. The agreement shall be renewable monthly, quarterly, or yearly.

END OF SECTION

SECTION 28 20 00 - 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. Section includes expansion of an existing video management system consisting of color IP surveillance cameras and data transmission wiring to network switches. Connect cameras to existing digital network video recorder and other associated head-end equipment. Configure and program all cameras for monitoring, adminstration, and playback on Owner's existing equipment.

1.3 DEFINITIONS

A. BNC: Bayonet Neill-Concelman - type of connector.

B. FTP: File transfer protocol.

C. IP: Internet protocol.

D. LAN: Local area network.

E. MPEG: Moving picture experts group.

F. NTSC: National Television System Committee.

G. NVR: Network Video Recorder

H. PC: Personal computer.

I. PTZ: Pan-tilt-zoom.

J. TCP: Transmission control protocol - connects hosts on the Internet.

K. UPS: Uninterruptible power supply.

L. VMS: Video Management System

M. WAN: Wide area network.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
4. UPS: Sizing calculations.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Design Data: Include an equipment list consisting of 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.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Product Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

B. User Licenses: For cameras, recorders, and other equipment as appropriate.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg Fand a relative humidity of 20 to 80 percent, noncondensing.

2. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg Fdry bulb and 20 to 90 percent relative humidity, noncondensing. Use 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 Fdry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mphand snow cover up to 24 inchesthick. Use NEMA 250, Type 4 enclosures.
4. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.8 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: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

2.2 PERFORMANCE REQUIREMENTS

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

B. Comply with NECA 1.

C. Comply with NFPA 70.

2.3 COLOR CAMERA, INTERIOR, FIXED

A. Features:

1. 1/2.8" Progressive Scan
2. 3.4 - 8.9 mm lens
3. Motion JPEG and MPEG-4 video compression
4. Up to 30 frames per second
5. Multi-casting and multi-video streaming
6. Auto-iris lens
7. Indoor vandal resistant housing
8. Flush mounted dome and housing cover
9. Pole mounted dome and housing cover
10. Two-way half-duplex audio support
11. Power Over Ethernet 802.3af Class 3

B. Manufacturer/Model: Axis P3245-LV (no exceptions)

2.4 COLOR CAMERA, EXTERIOR, FIXED

A. Features:

1. 1/2.8" Progressive Scan
2. 3.4 - 8.9 mm lens
3. Motion JPEG and MPEG-4 video compression
4. Up to 30 frames per second
5. Multi-casting and multi-video streaming
6. Auto-iris lens
7. Outdoor vandal resistant housing
8. Flush mounted dome and housing cover
9. Two-way half-duplex audio support
10. Power Over Ethernet 802.3af Class 3

B. Manufacturer/Model: Axis P3245-LVE (no exceptions)

2.5 360-degree Multisensor Camera

A. Features:

1. 4 x 1/2.8• • progressive scan RGB CMOS
2. Varifocal lens, 3-6mm, F2.0
3. 0.17lux, F2.0
4. Motion JPEG and MPEG-4 video compression
5. Up to 30 frames per second
6. Multi-casting and multi-video streaming
7. Auto-iris lens
8. Indoor/outdoor vandal resistant housing
9. Power over Ethernet 802.3af Type 1 Class 2, max 5.5 W

B. Manufacturer/Model: Axis P3727-PLE (no exceptions)

2.6 180-degree Multisensor Camera

A. Features:

1. 4 x 1/1.9” progressive scan CMOS
2. 3 x lenses, fixed focus, 3.2 mm, F2.0
3. Color image: 0.17 lux, F2. - B&W image: 0.05 lux, F2.0
4. Motion JPEG and MPEG-4 video compression
5. Up to 30 frames per second
6. Multi-casting and multi-video streaming
7. Auto-iris lens
8. Indoor/outdoor vandal resistant housing
9. Power over Ethernet 802.3af Type 1 Class 3, max 12.9 W

B. Manufacturer/Model: Axis P3807-PVE (no exceptions)

2.7 IP ENCODER

A. Features:

1. Multiple H.264 streams per channel
2. Full frame rate in all resolutions
3. Intelligent video capabilities
4. Two-way audio support

B. Manufacturer/Model: Axis Q7424-R (no exceptions)

2.8 POWER SUPPLIES

A. Cameras: Power-Over-Ethernet (POE) compatible.

B. Low-voltage power supplies matched for voltage and current requirements of system accessories, and of type as recommended by manufacturer.

1. Enclosure: NEMA 250, Type 1.

2.9 COPPER PATCH PANEL

A. Features:

1. Universal T568A and T568B wiring cards for 110-style IDC terminations
2. Color-coded front labeling for easy port identification; ANSI/TIA-606-B compliant
3. Terminates 26-22 AWG solid conductors
4. Color: Orange

2.10 SIGNAL TRANSMISSION COMPONENTS

A. Infrastructure Cabling: Category 6.

1. ISO listed, National Electric Code type CMP, plenum rated
2. 4-pair unshielded twisted pair (UTP)
3. Nominal outside diameter: 5.3mm
4. 14 pf/m nominal capacitance
5. Color: Pink
6. Snagless plug hoods

B. Patch Cords: Category 6.

1. ISO listed, National Electric Code type CM
2. 4-pair unshielded twisted pair (UTP)
3. Nominal outside diameter: 5.3mm
4. 14 pf/m nominal capacitance
5. Color: Orange
6. Snagless plug hoods
7. Furnish cables of appropriate length with no excess to be looped in a wire management system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

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

3.2 WIRING

A. Comply with requirements in Section 27 05 28 "Pathways for Communications Systems."

B. Wiring Method: Install cables in raceways unless otherwise indicated.

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-486B.

E. For communication wiring, comply with the following:

1. Section 27 15 13 "Communications Copper Horizontal Cabling."

F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras level and plumb.

B. Mount interior cameras on a ceiling surface or on a pendant secured to the structure. Mount exterior cameras on a wall or ceiling surface or on a teardrop mount. Coordinate exact mounting location of each camera with Owner.

C. Provide cameras with varifocal lenses so that each camera target can be easily adjusted. Label each camera according to location and/or targeting; coordinate labeling with Owner.

D. Confirm intended target for each camera with Owner. Verify field conditions with Owner to confirm exact location, mounting height, pan, tilt, and zoom for each camera prior to installation.

E. Install cameras with 84-inch- minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

F. 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.

G. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

H. Avoid ground loops by making ground connections only at the control station.

1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

I. Identify system components, wiring, cabling, and terminals according to Section 27 05 53 "Identification for Communications Systems." Provide label for each camera indicating location and/or targeting. Review labeling with Owner prior to installation.

J. Program cameras using naming conventions provided by Owner.

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. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. 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:

a. Prepare equipment list described in "Informational Submittals" Article.
b. Verify operation of auto-iris lenses.

c. 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.
d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feetaway. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
e. Set and name all preset positions; consult Owner's personnel.
f. Set sensitivity of motion detection.
g. Connect and verify responses to alarms.
h. Verify operation of control-station equipment.

3. 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.
4. 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.

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

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within twelve months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose. 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. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 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.

END OF SECTION

SECTION 28 46 21 - ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Provide a complete and fully functioning intelligent addressable fire alarm system.
   1. Alarm tone evacuation: Control panel shall be equipped with the necessary hardware to allow for pulsed, steady state and temporal alarm tones.

B. Section Includes:

   1. Fire alarm control unit and accessories.
   2. Detectors.
   3. Notification appliances.
   4. Addressable interface device.
   5. Knox Box.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire alarm system. Fire alarm drawings are schematic in nature indicating system requirements and intended coverage and functionality. Shop drawings shall indicate full system and confirm conformance with all applicable codes and standards.

   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
   4. Detail assembly and support requirements.
   5. Include voltage drop calculations for notification-appliance circuits.
   6. Include battery-size calculations.
   7. Include input/output matrix.
   8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
   9. Include performance parameters and installation details for each detector.
   10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire alarm system design.
b. NICET-certified, fire alarm technician; Level II minimum. Submit copy of NICET certificate with shop drawings.

D. Deferred Submittal:

1. Upon approval of submittals, Engineer will provide Electrical Contractor with deferred submittal letter indicating conformance with design documents and all applicable codes per Pennsylvania UCC requirements.
2. Submit deferred submittal letter along with approved shop drawings to authority having jurisdiction for final approval.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire alarm systems and components to include in emergency, operation, and maintenance manuals.

B. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
3. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
4. Riser diagram.
5. Device addresses.
6. Record copy of site-specific software.
7. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

a. Equipment tested.
b. Frequency of testing of installed components.
c. Frequency of inspection of installed components.
d. Requirements and recommendations related to results of maintenance.
e. Manufacturer's user training manuals.
8. Manufacturer's required maintenance related to system warranty requirements.
9. Abbreviated operating instructions for mounting at fire alarm control unit and each annunciator unit.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire alarm Level II technician.

C. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.8 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, FM Global-placarded addressable system, with multiplexed signal transmission and horn/strobe evacuation.

B. Automatic sensitivity control of certain smoke detectors.

C. All components provided shall be listed for use with the selected system.

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.

2.2 SYSTEM COORDINATION

A. Remote Monitoring:

1. Provide supervised digital communicator for connection to an off-site monitoring station. Modules shall notify off- site monitoring for both alarm and trouble separately. Coordinate with Owner and fire alarm equipment supplier for central station monitoring agreement.

2.3 SYSTEM OPERATIONAL DESCRIPTION

A. Fire alarm signal initiation shall be by one or more of the following devices:

1. Heat detectors.
2. Smoke detectors.
3.

B. Fire alarm signal shall initiate the following actions:

1. Continuously operate alarm audible and visual notification appliances.
2. Identify alarm and specific initiating device at fire alarm control unit[, connected network control panels, off-premises network control panels,] and remote annunciator(s).
3. Transmit an alarm signal to the remote alarm receiving station.
4. Activate exterior notification device and/or alarm bell.
5. Record events in the system memory.
6.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. User disabling of zones or individual devices.
2. Loss of communication with any panel on the network.

D. Supervisory signal shall initiate the following actions:

1. Identify specific initiating device at fire alarm control unit, connected network control panels, off-premises network control panels, and remote annunciator(s).
2. Transmit a supervisory signal to the remote alarm receiving station.
3. Record events in the system memory.
4.

E. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire alarm control unit.
5. Ground or a single break in internal circuits of fire alarm control unit.
6. Abnormal ac voltage at fire alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire alarm control unit or annunciator.

F. System trouble signal shall initiate the following actions:

1. Identify specific initiating device at fire alarm control unit, connected network control panels, off-premises network control panels, and remote annunciator(s).
2. Transmit a trouble signal to the remote alarm receiving station.
3. Record events in the system memory.
4.

2.4 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by Simplex / Johnson Controls in accordance with Owner standards, no substitutions.

B. All devices and peripherals shall be of the same manufacturer as the fire alarm control unit, unless otherwise indicated.

2.5 FIRE ALARM CONTROL UNIT

A. Basis of Design System: JCI 4100ES Series.

B. General Requirements for Fire Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.

d. The FACP shall be listed for connection to a central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

a. One dedicated RS 485 port for station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble and supervisory signals, and transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
4. Base:

    a. Type: Standard base.
    b. Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and status.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 200 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:

a. As indicated on drawings.
b. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall- or ceiling-mounted as indicated on drawings.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.9 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to third-party device.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Mounting: wall-mounted.

2.10 RADIO ALARM TRANSMITTER

A. Transmitter shall comply with NFPA 1221 and 47 CFR 90.

B. Description: Manufacturer's standard commercial product; factory assembled, wired, and tested; ready for installation and operation.

1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
3. Normal Power Input: 120-V ac.
4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph with a gust factor of 1.3 without failure.
6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
7. Antenna-Cable Connectors: Weatherproof.
8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.

C. Functional Performance: Unit shall receive alarm, supervisory, or trouble signal from fire alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:

1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
4. Local Fire Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
5. Local Fire Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
6. Local Fire Alarm-System, Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

2.11 NETWORK COMMUNICATIONS

A. Provide network communications for fire alarm system according to fire alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet for connection to building automation system.

PART 3 - EXECUTION

3.1 ABANDONED CABLES

A. Remove accessible portions of all existing, abandoned or unused fire alarm cables in accordance with NFPA 70 requirements.

3.2 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

3.3 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B, as applicable, in NFPA 72.
5. Center in accessible ceiling tiles wherever possible.
6. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
7. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

D. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

E. Notification Appliances:

1. Where both audible-only devices and audible-visible or visible only devices are installed in the same space, install all notification appliances at 96 inches to center-line of device, minimum of 6 inches below the ceiling.
2. Audible Alarm-Indicating Devices: Install on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Mount so that no part of speaker portion of the device is lower than 90 inches above finished floor and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
3. Visible Alarm-Indicating Devices: Install on flush-mounted back boxes. Mount so that no part of the lens is lower than 80 inches above finished floor and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

G. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists 100-mph wind load with a gust factor of 1.3 without damage.

3.4 WIRING METHODS

A. Wiring Method: Install all interior wiring in raceways.

1. Comply with requirements for raceways and boxes specified in Section 27 05 28 "Pathways for Communications Systems."

3.5 PATHWAYS

A. Cabling shall be installed in EMT.

B. Exposed EMT containing fire alarm cabling shall be either red or painted red enamel.

3.6 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to activate emergency lighting control.

2. Supervisory connections at valve supervisory switches.
3. Data communication circuits for connection to building management system.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 27 05 53 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire alarm control unit.

C. Provide a secure documentation cabinet located adjacent to the fire alarm control unit in accordance with NFPA 72 requirements. Coordinate mounting location in field.

3.8 GROUNDING

A. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.9 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by or approved by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire alarm system.

END OF SECTION

SECTION 311000 - SITE CLEARING

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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing site utilities.
7. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

SECTION 32 9119

LANDSCAPE GRADING

PART 1 GENERAL

1.00 RELATED DOCUMENTS

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

1.01 WORK INCLUDED

A. Provide all equipment and materials, and do all work necessary to complete the site grading as indicated on the Drawings and as specified.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 01 40 00, QUALITY REQUIREMENTS; Topsoil and other planting materials testing.
2. Section 31 23 00, SITE EXCAVATING, BACKFILLING AND COMPACTING; Excavation, backfill; establishment of subgrade elevations.
3. Section 32 92 00, LAWNS AND GRASSES.
4. Section 32 93 00, TREES, PLANTS AND GROUND COVERS.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

D 698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (6000kN-m/m³))
D 1556	Density of Soil in Place by the Sand-Cone Method
D 2167	Density and Unit Weight of Soil In Place by the Rubber-Balloon Method

1.04 EXISTING CONDITIONS

A. By submitting a bid, the Contractor affirms that he has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.

1.05 QUALITY CONTROL

A. The Architect reserves the right to perform on-site observation during the grading operations. The observations may include, but not be limited to the following:

1. Observation of subgrade preparation for slab-on-grade and paved areas.
2. Observation of rough and finish grading operations.

B. All grade breaks shall be staked with grade stakes at each end, any change of direction, and at 20' centers along the length for Architect's review during grading operations.

C. All wetlands shall be staked with grade stakes at upper perimeter and lower perimeter for review and approval by Architect.

D. Perform field density tests in accordance with ASTM D 1556 or ASTM D 2167.

1. Make at least one field density test of the subgrade for every 2000 sq. ft. of paved area, but in no case less than three tests.
2. In each compacted fill layer, make one field density test for every 2000 sq. ft. of overlaying paved area, but in no case less than three tests.
3. Make at least one field density test of the planting soil for every 2000 sq. ft. of plant bed area, but in no case less than three tests.
4. Make at least one field density test of the planting soil for every 2000 sq. ft. of lawn area, but in no case less than three tests.

D. If, in the opinion of the Architect, based on reports of the testing service and inspection, the subgrade or fills which have been placed are below the specified density, additional compaction and testing will be required until satisfactory results are obtained.

1. The results of density tests of soil-in-place will be considered satisfactory if the average of any four consecutive density tests which may be selected are in each instance equal to or greater than the specified density, and if not more than one density test out of five has a value more than 2% below the required density.

E. The Architect's presence does not include supervision or direction of the actual work by the Contractor, his employees, or agents. Neither the presence of the Architect, nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.

1.06 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. The work shall be executed in such manner as to prevent any damage to adjacent property and any other property and existing improvements such as, but not limited to: streets, curbs, paving, utility lines and structures, monuments, bench marks and other public and private property.

B. In case of any damage or injury caused in the performance of the grading work, the Contractor shall, at his own expense, make good such damage or injury to the satisfaction of, and without cost to the Owner. Existing roads, sidewalks, and curbs damaged during the grading work shall be repaired or replaced to their original condition at the completion of operations. The Contractor shall replace, at his own cost, existing bench marks, monuments, and other reference points which are disturbed or destroyed.

1.07 COORDINATION

A. Prior to start of grading operations, the Contractor shall arrange an on-site meeting with the Architect for the purpose of establishing Contractor's schedule of operations and scheduling inspection procedures and requirements.

B. As construction proceeds, the Contractor shall be responsible for notifying the Architect prior to start of grading operations requiring inspection and/or testing.

C. The Contractor shall be responsible for obtaining test samples of soil materials proposed to be used and transporting them to the site sufficiently in advance of time planned for use of these materials for testing of materials to be completed. Use of these proposed materials by the Contractor prior to testing and approval or rejection, shall be at the Contractor's risk.

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIALS

A. Material shall be obtained from required on-site excavation, to the extent that suitable material is available, and from off-site sources, to the extent that suitable material is not available from on-site excavation.

B. Refer to Section 32 92 00 and Section 32 93 00 for preparation and placement of planting soils.

PART 3 - EXECUTION

3.01 SUBGRADE COMPACTION

A. Refer to Section 31 23 00, SITE EXCAVATING, BACKFILLING AND COMPACTING for required levels of subgrade compaction at paved areas.

1. Unless otherwise indicated, scarified subgrade in landscape areas shall be compacted to 86% - 88% compaction ASTM D698 Standard Proctor.
2. Planting Soil – Planting Pits and Beds: shall be spread in lifts not greater than twelve inches and compacted to a density between 82 and 86 percent Standard Proctor Maximum Dry Density.
3. Planting Soil - Lawn Areas: shall be spread over the area and shall be compressed to a density of 86 to 88% Standard Proctor maximum dry density. No vibratory compaction of the subgrade or the planting medium shall take place. No rubber-tired equipment or heavy equipment except for a small bulldozer shall pass over soils after they have been loosened or planting medium spread.

3.02 GRADING - GENERAL

A. Uniformly grade areas within the limits of site grading under this section, including adjacent transition areas. Smooth finished surfaces within specified tolerances, and between points where elevations are shown, or between such points and existing grades.

B. The degree of finish required will be that ordinarily obtainable from either blade-grader or scraper operations.

1. Ditches: Finish ditches to ensure proper flow and drainage. Conduct final rolling operations to produce a hard, uniform, and smooth cross-section.
2. Grade Breaks located on the plans indicate crisp transitions, not blended or rounded edges. These should be clean, sharp, and uniform in line and curve as indicated on the plans

3.03 ROUGH GRADING

A. General: Rough grading shall include the shaping, trimming, rolling and refinishing of all surfaces of the subbase, shoulders, earth embankments and the preparation of grades as shown on the Drawings. The grade of shoulders and sloped areas may be done by machine methods.

B. Do all cutting, filling and grading to lines and grades indicated on the Drawings. Grade evenly to within the dimensions required for grades shown on the Drawings and specified herein. No stones larger than 2 in. shall be placed in uper 6 in. of fill. Fill shall be left in compacted state at the end of work day and sloped to drain.

1. Architect may make such adjustments in gardes and alignments as are found necessary to avoid special conditions encountered.
2. Provide a smooth transition between adjacent existing grades and new grades.
3. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

C. 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 (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).
4. Up to 2 in. in 10 ft. – 0 in. tolerance shall be permitted on slopes provided the slopes are uniform in appearance and without any abrupt changes.
5. Traffic of men and equipment across soil subgrade areas shall be prohibited following excavation to the required lines and grades.

3.04 FINE GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between 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. Finish Grading:

1. Lawn or Unpaved Areas: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
2. Walks: Shape the surface of areas under walks to line, grade and cross-section, with the finish surface not more than 0.00 ft. above or 0.10 ft. below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains.
3. Pavements: Shape the surface of the areas under pavement to line, grade and cross-section, with the finish surface not more than 1/2 in. above or below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains. Include such operations as plowing, discing, and any moisture or aerating required to provide the optimum moisture content for compaction. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil material. Shape to line, grade, and cross-section as shown on the Drawings.

3.05 MAINTENANCE

A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.

C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, re-shape, and compact to the required density prior to further construction.

3.06 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove waste materials, including excavated material classified as unsatisfactory soil material, trash and debris, and dispose of it legally off the Owner's property.

3.07 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan.

END OF SECTION

SECTION 32 9200

LAWNS AND GRASSES

PART 1 GENERAL

1.00 RELATED DOCUMENTS

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

1.01 WORK INCLUDED

A. Provide all materials and equipment, and do all work required to complete the seeding including furnishing and placing planting soil, as indicated on the Drawings and as specified.

1. Any landscape area disturbed by Contractor and not showing specific proposed planting treatment, shall be loamed and seeded as specified herein at no additional cost to the Owner.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 31 23 00, SITE EXCAVATING, BACKFILLING AND COMPACTING; Excavation and backfill and establishment of subgrade elevations.
4. Section 32 93 00, TREES, PLANTS, AND GROUND COVERS; New plantings.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

C 136	Sieve Analysis of Fine and Coarse Aggregates
D 422	Particle-Size Analysis of Soils
E 11	Wire-Cloth Sieves for Testing Purposes

1.04 SUBMITTALS

A. Samples: The following samples shall be submitted:

Material	Quantity (lb.)

B. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following materials:

Aluminum sulfate
Lime
Seed
Loam borrow
Fertilizer

C. Certificates: Labels from the manufacturer's container certifying that the product meets the specified requirements shall be submitted for the following materials:

Commercial fertilizer
Grass seed
Ground limestone
Seed mix for sod

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

1.05 OWNER'S INSPECTION AND TESTING

A. Work will be subject to inspection at all times by the Architect. The Owner reserves the right to engage an independent testing laboratory in accordance with requirements of 01 45 00, QUALITY CONTROL to analyze and test materials used in the construction of the work. Where directed by the Architect, the testing laboratory will make material analyses and will report to the Architect whether materials conform to the requirements of this specification.

1. Cost of tests and material analyses made by the testing laboratory will be borne by the Owner when they indicate compliance with the specification, and by the Contractor when they indicate non-compliance.
2. Testing equipment will be provided by and tests performed by the testing laboratory. Upon request by the Architect, shall provide such auxiliary personnel and services needed to accomplish the testing work.
3. Gradation of granular materials shall be determined in accordance with ASTM C 136. Sieves for determining material gradation shall be as described in ASTM E 11.

1.06 CONTRACTOR'S INSPECTION AND TESTING

A. The Contractor shall engage an independent testing agency, experienced in the testing of agricultural soils and acceptable to the Architect, to perform the topsoil/planting soil tests and analyses specified herein. All costs associated with testing shall be the Contractor's responsibility.

1. Particle size analysis shall include the following gradient of mineral content:

USDA Designation	Size in mm
Gravel	+ 2 mm
Very coarse sand	1-2 mm
Coarse sand	0.5-1 mm
Medium sand	0.25-0.5 mm
Fine sand	0.1-0.25 mm
Very fine sand	0.05-0.1 mm
Silt	0.002-0.05 mm
Clay	< 0.002 mm

2. Chemical analysis shall include the following:

a. pH and buffer pH
b. percentage of organic content by oven-dried weight
c. Nutrient levels by parts per million, including phosphorus, potassium, magnesium, manganese, iron, zinc, and calcium. Nutrient test shall include testing laboratory recommendations for supplemental additions to the soil, if necessary, based on the requirements for ornamental horticultural plants. Recommendations shall include rates at which additives are to be applied.
d. Soluble salt by electrical conductivity of a 1:2 soil/water sample.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver seed in original sealed containers, labeled with analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, location of packaging, and name of seed grower. Damaged packages will not be accepted.

B. Seed shall be stored under cool and dry conditions so that the endophytic seed in the mixture is capable of maintaining a high level of endophytes

C. Deliver fertilizer in sealed waterproof bags, printed with manufacturer's name, weight, and guaranteed analysis.

1.08 PLANTING SEASON

A. Planting season shall be as follows:

Material	Planting Season	
	Spring	Fall
Seeding	3/15 to 4/15	8/15 to 9/15

B. Planting shall only be performed when weather and soil conditions are suitable for planting the material specified in accordance with locally accepted practice.

C. Planting season may be extended with the written permission of the Architect.

1.09 ACCEPTANCE

A. Acceptance:

1. The Architect will inspect all work for Substantial Completion upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.
2. Acceptance of material by the Architect will be for general conformance to specified requirements, and shall not relieve the Contractor of responsibility for full conformance to the Contract Documents.
3. Upon completion and reinspection of all repairs or renewals necessary in the judgement of the Architect, the Architect will recommend to the Owner that the work of this Section be accepted.

B. Seed areas will be accepted when in compliance with all the following conditions:

1. All areas show a uniform stand of specified grass in healthy condition.
2. At least 60 days have elapsed since the completion of work under this Section.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

1. Certified Landscape Technician - Exterior, with installation and/or maintenance specialty area(s), designated CLT-Exterior.
2. Certified Landscape Technician - Interior, designated CLT-Interior.
3. Certified Ornamental Landscape Professional, designated COLP.

C. Pesticide Applicator: State licensed, commercial.

D. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

PART 2 PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed mixture: Standard grade seed of the most recent season's crop. Seed shall be dry and free of mold. Where possible, seed shall be inoculated with endophytes. Seed mixture shall be as follows:

C. Seed mix shall be 100% Penn State Mix:

Line drive II Perennial ryegrass 49.16%
creeping red fescue 29.24%
Kentucky bluegrass 18.06%
Inert 3.02%
Other crop .51%
Weed seed .01%

2.02 PLANTING SOIL

A. Existing Topsoil

1. Existing topsoil from on-site source(s) may be used for planting soil, to the extent available, if it meets the requirements of this Section for planting soil, or if approved by the Architect.

B. Planting Soil

1. Planting soil shall be composed of a natural, fertile, friable soil typical of cultivated topsoils of the locality, suitable for the germination of seeds and support of vegetative growth, with additives, if required, to achieve particle distribution and organic content specifications . Topsoil shall be taken from a well-drained, arable site, free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots, other objectionable, extraneous matter or debris nor contain toxic substances. Planting soil shall have a pH value between 5.5 and 6.5 and organic matter content of 5 to 10% of total dry weight.
2. Planting soil shall have the following mechanical analysis (see paragraph 1.06 for particle sizes):

Approximate Particle Distribution	
Gravel	Less than 10%
Coarse to medium sand	55 – 65%
Fine to very fine sand	15 – 25%
Silt	10– 20%
Clay	15 – 20%

3. Minimum planting soil nutrient levels shall be: Nitrogen @ 5% average of organic matter, Phosphorus @ .02 to .05% average of total soil content, Potassium @ 1.2% average of total soil content.
4. The Contractor shall provide the Architect with planting soil test results, as specified in Paragraph 1.05, before the start of planting operations. If planting soil does not fall within the required particle distribution, organic content, or pH range, it shall be adjusted to meet the specifications through the addition of sand, compost, limestone, or aluminum sulfate to bring it within the specified limits.

2.03 COMPOST (Planting Soil Amendment)

A. Compost shall be derived from organic wastes such as food and agricultural residues, animal manures, mixed solid waste and biosolids (treated sewage sludge) that meet all State Environmental Agency requirements. The product shall be well composted, free of viable weed seeds and contain material of a generally humus nature capable of sustaining growth of vegetation, with no materials toxic to plant growth.

1. Compost shall have the following properties:

Parameters	Range
pH	5.5 – 8.0
Moisture Content	35% - 55%
Soluble Salts	≤ 4.0 mmhos (dS)
C:N ratio	15 – 30:1
Particle Size	< 1”
Organic Matter Content	> 50%
Bulk Density	< 1000 lbs./cubic yard
Foreign Matter	< 1% (dry weight)

2. Compost generator shall also provide minimum available nitrogen and other macro and micro nutrients to determine fertilizer requirements.
3. Compost shall be “AllGro”, distributed by AllGro, 4 Liberty Lane West, Hampton, NH 03842; “Agresoil”, distributed by Agresource, 100 Main Street, Amesbury, MA 01913; or approved equal.
4. Guidelines for quantity of compost required to achieve suitable soil organic content in soil mixes for ornamental horticultural planting shall be as recommended by the compost manufacturer.

2.04 PEAT MOSS

A. Peat moss shall be a horticultural grade, sphagnum peat moss containing partially decomposed fibrous or cellular stems and leaves of any of the many species of sphagnum mosses from fresh water sources conforming to the following requirements:

1. Peat moss shall be a homogenous material free of decomposed colloidal residue lumps, roots, stones, and other foreign matter; and of such consistency that peat can be pass a 1/2 in. mesh and can be readily incorporated with the topsoil.
2. The pH shall not be less than 3.5 nor greater than 6.0 at 25 degrees C.
3. Organic matter content shall be not less than 90%, by weight, on an oven-dry basis.
4. Ash content shall not be more than 10%, by weight, on an oven-dry basis.
5. Moisture absorption capacity shall not be less than 800%, by weight, on an oven-dry basis.

2.05 LIMESTONE

A. Lime shall be an approved agricultural limestone containing no less than 50% of total carbonates, and 25% total magnesium with a neutralizing value of at least 100%. The material shall be ground to such a fineness that 40% will pass through a No. 100 U.S. Standard Sieve, and 98% will pass through a No. 20 U.S. Standard Sieve. The lime shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any lime which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.

2.06 WATER

A. Water shall be suitable for irrigation and free from ingredients harmful to seeded or sodded areas.

2.07 ALUMINUM SULFATE

A. Aluminum sulfate shall be unadulterated and shall be delivered in containers with the name of the material and manufacturer, and net weight of contents.

2.08 COMMERCIAL FERTILIZER

A. Starter fertilizer shall be HD Scotts Starter Fertilizer or approved equal.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition (When applied as a topsoil amendment): Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency. Manufacturer’s literature shall be submitted for approval.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

D. When used as a top dressing for the maintenance of sod, fertilizer shall conform to the following:

Constituent	% Present by Weight
Nitrogen (N)	10
Phosphorous (P	8
Potassium (K)	4

a. 50% of nitrogen shall be derived from natural organic source of ureaform.
b. Available phosphorus shall be derived from superphosphate, bone meal, or tankage.
c. Potassium shall be derived from muriate of potash containing 60% potash.

E. Fertilizer shall be delivered in manufacturer's standard container printed with manufacturer's name, material weight, and guaranteed analysis.

F. Fertilizers with N-P-K analysis other than that stated above may be used provided that the application rate per square foot of nitrogen, phosphorus, and potassium is equal to that specified.

2.09 SUPERPHOSPHATE

A. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes, and containing not less than 20% available phosphoric acid. The superphosphate shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any superphosphate which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.

2.10 MULCHES

A. Cellulose fiber mulch shall be composed of 100% Thermally Refined wood fiber with the highest quality cellulose, delivering up to 15% greater yield, contain a green color additive, be weed free, and non-polluting, containing no germination or growth - inhibiting factors, similar to Conwed Fibers EnviroBlend with TriFlo, manufactured by Conwed Fibers, Profile Products LLC, 750 Lake Cook Rd, Suite 440, Buffalo Grove, IL 60089; Phone: 800-207-6457; Fax: 847-215-0577.

B. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

C. Peat Mulch: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

D. Peat Mulch: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.

2.11 EDGING

A. Steel edging shall be Border Concepts Edging,"Border King", manufactured by Border Concepts, Inc., P.O. Box 471185, Charlotte, NC 28247 or approved equal. Steel edging shall be shop fabricated, primed and painted black.

1. Steel edging shall have slotted holes for staking steel edging every 30 in. o.c.
2. Steel stakes shall be 15 in. long, tapered.
3. Provide manufacturer's end stake and splicer unit.
4. Provide manufacturer's optional preformed tree rings and tree squares as indicated on the Drawings.

5. Provide manufacturer's standard touch-up paint for in field touch-up of scratched or marred areas.

2.12 FILTER FABRIC

A. Filter fabric shall be a non-woven polypropylene fabric made specifically for use in subsurface drainage structures equal to Mirafi 140N, manufactured by Tencate Geosynthetics, 365 South Holland Drive, Pendergrass, GA 30567; Tel 800 685 9990; Tel 706 693 2226; Fax 706 693 4400; www.mirafi.com, or approved equal.

2.13 SOIL STABILIZATION FABRIC

A. Soil stabilization fabric shall be "Enkamat 7010", three dimensional geomatrix of heavy nylon filaments fused at their intersections with 95% open space available for soil and root interaction with filaments, manufactured by Akzo Nobel Geosynthetics Company, Asheville, NC 28802, or approved equal.

B. Staple for anchoring erosion control netting shall be No. 8 gage steel wire, bent U-shaped, with throat width of 1 to 2 in. and effective driving depth not less than 8 in.

2.14 WEED CONTROL

A. Weed control for stockpiled topsoil shall be a non-selective weed killer for control of grassy and broadleaf weeds; weed control shall have short residual, allowing seeding or sodding operations to occur within 7 days of application.

PART 3 EXECUTION

3.01 PREPARATION OF SUBGRADE

A. Subgrade shall be examined to ensure that rough grading and all other subsurface work in lawn areas and other areas to be seeded is done prior to start of seeding and sodding.

B. Limit subgrade preparation to areas that will be planted in the immediate future.

C. Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials.

D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:

3.02 SPREADING OF PLANTING SOIL

A. Planting soil shall not be spread and fine graded until it is possible for Architect to inspect within 48 hours and for areas to be seeded within 48 hours of Architect approval. Areas that must be seeded later than 48 hours following Architect approval shall only be done so with Architect written approval.

B. Planting soil shall not be placed when subgrade or topsoil material are frozen, excessively wet, or excessively dry.

C. Planting soil shall be spread in a uniform layer, to a thickness which will compact to the depth required to bring final lawn and grass surfaces to required elevation. Unless otherwise indicated, minimum depth of topsoil for sodded areas shall be 6 in., and minimum depth of topsoil for seeded areas shall be 8 in.

1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.

D. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches (38 mm) in any dimension, and other objects that may interfere with planting or maintenance operations. Refer to Section 329119, LANDSCAPE GRADING.

E. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.03 APPLICATION OF FERTILIZER AND CONDITIONERS

A. Fertilizer and conditioners shall be applied at the following rates:

1. Peat moss - as required by test results of topsoil..
2. Limestone - as required by test results of topsoil.
3. Fertilizer - as required by test results of topsoil.

B. Mixing with topsoil:

1. Fertilizer and conditioners shall be spread over the entire lawn areas at the application rates indicated above.
2. Materials shall be uniformly and thoroughly mixed into the top 4 in. of topsoil by discing, rototilling, or other approved method.

3.04 FINISH GRADING

A. Contractor shall set grade lines for Landscape Architect’s review and approval.

1. Final surface of topsoil immediately before seeding and sodding shall be within $\pm$ 1/2 in. of required elevation, with no ruts, mounds, ridges, or other faults, and no pockets or low spots in which water can collect. Stones, roots, and other debris greater than 1 in. in any dimension, which are visible at the surface, shall be removed and the resulting holes filled with topsoil, leaving a uniform planar surface.

B. Finish grade surface with a drag or rake. Smooth down all lumps and ridges, fill in all holes and crevices. Rolling with a light roller is acceptable, if the surface is scarified afterward.

1. Grade Breaks located on the plans indicate crisp transitions, not blended or rounded edges. These should be clean, sharp, and uniform in line and curve as indicated on the plans
2. Lawn: Compaction of topsoil for finish grade shall be 85% to 88%.

C. In the event of settlement, the Contractor shall readjust the work to required finished grade.

3.05 EDGING

A. Steel edging shall be installed at locations indicated on the Drawings. Where required, edging shall be cut square and accurately to required length.

1. Steel edging shall be securely staked in required position. Stakes shall be driven every 30 in. o.c. along length of edging.
2. Adjacent lengths of edging shall be spliced together with manufacturer's standard splicer unit.
3. Edging shall be set plumb and vertical at required line and grade. Straight sections shall not be wavy; curved sections shall be smooth and shall have no kinks or sharp bends.

3.06 SEED APPLICATION

A. Seed shall be broadcast by means of an approved mechanical spreader, to give a uniform application at the following rates:

Seed	Application Rate lb./1,000 s.f.
Penn Dot Formula B	4.0
Penn State Seed Mix	Confirm with PSU

B. Seed shall be applied in two equal applications for uniform coverage; direction of travel of spreader for second pass shall be perpendicular to that of the first pass. Seeding shall not be done when it is raining or snowing, or when wind velocity exceeds 5 mph.

C. At the Contractor's option, and with the permission of the Architect, seed may be spread by the hydroseeding method, utilizing power equipment commonly used for that purpose.

1. Seed shall be applied in two equal applications for uniform coverage; direction of second pass shall be perpendicular to that of the first pass. Seeding shall not be done when it is raining or snowing, or when wind velocity exceeds 5 mph.
2. Seed, lime, fertilizer, and mulch shall be mixed and applied to achieve application quantities specified herein for the conventional seeding method, with mulch applied at the rate of 1,200 lb./acre. Other provisions specified above for conventional seeding shall apply also to hydroseeding.
3. Mulch shall be applied in two stages with 5% to 10% of the quantity applied with seed and the balance applied separately.
4. Seed shall not be placed in water until immediately before application.
5. Centrifugal pumps shall not be used to apply seed mix without fiber mulch. Hand broadcast or use gear pump.

D. Following seeding the area shall be lightly raked to mingle seed with top 1/8 to 1/4 in. of soil. Area shall then be fine graded. Stones and other debris greater than 1 in. in any dimension which are visible on surface shall be removed. Surface shall be rolled with a hand roller having a weight of 60 to 90 lb./ft. of width, and a minimum diameter of 2 ft.

E Following seeding and raking, entire area shall be watered by use of lawn sprinklers, or other approved means. Initial watering shall continue until the equivalent of a 2 in. depth of water has been applied to entire seeded surface, at a rate which will not dislodge the seed. Watering shall be repeated thereafter as frequently as required to prevent drying of the surface, until the grass attains an average height of 1/4 in. Watering methods and apparatus which may cause erosion of the surface shall not be permitted.

F. Rope off entire seeded area to prevent vehicles and pedestrians from entering area.

3.07 LAWN RENOVATION

A. Renovate existing lawn.

B. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.

C Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

D. Where substantial lawn remains, mow, dethatch, core aerate, and rake. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

1. Aeration shall be accomplished utilizing a roller, drum or piston-type aerator with coring or open-spoon tines of 1/2 in. to 3/4 in. diameter. Tines shall penetrate the soil to a minimum depth of 1-1/2 in. Final aeration pattern shall provide a minimum of 4 aeration holes per square foot of surface area.
   a. Aeration cores shall not be collected.
   b. Aeration shall be provided between March 1and May 1.

2. Dethatching shall be accomplished as needed to maintain thatch levels less than 1/2 in. thick.
   a. Dethatching blades shall be adjusted so as to not cause damage to the turf which will detract from the quality of the turf 2 weeks after dethatching.
   b. Debris brought to the surface in the dethatching process shall be removed from the site.
   c. Dethatching shall be performed between April 1 and May 1 and between September 1 and October 15 only as needed as determined by the Contractor.

3. Overseeding of designated cool-season turf areas shall be accomplished between September 1 to October 15 or March 1 to May 1 utilizing a device or system which places the seed in direct contact with the soil.
   a. Overseeding of areas shall be preceded by dethatching as noted above when thatch buildup exceeds 1/2 in. thickness.

E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).

H. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 6 inches (100 mm) of existing soil. Provide new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new lawns.

K. Water newly planted areas and keep moist until new lawn is established.

3.08 MAINTENANCE

A. Except as otherwise specified below, maintenance shall include all operations required to produce an established lawn, including but not limited to:

Fertilizing
Mowing
Replanting
Watering
Weeding

B. Maintenance of seeded areas shall begin upon completion of seeding and shall continue until acceptance of the building, or until mowing as specified below is completed, or until average height of grass is 1-1/2 in., whichever occurs later.

1. Watering
   a. Week No. 1: Provide all watering necessary to keep seed bed moist at all times. Perform watering daily or as necessary to maintain moist soil to a depth of 4 in.
   b. Week No. 2 and Subsequent Weeks: Water as necessary to maintain adequate moisture in the upper 4 in. of soil to promote seed germination.

2. Mowing
   a. Mowing shall not be attempted until the sod is firmly rooted and securely in place. Not more than 40% of the grass leaf shall be removed during the first or subsequent mowings.
   b. Bluegrass and other cool season grasses shall be maintained between 1-1/2 in. and 2-1/2 in.
   c. All clippings shall be removed.

C. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding [90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm)]

D. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

E. First mowing shall be done when average height of grass is 2-1/2 in., with mower set to cut at a height of 1-1/ 2 in. Subsequent mowings shall be made at not over two week intervals, with the height of cut set at 1-1/2 in. With prior permission of the Owner, mowings during periods of slow growth or dormancy may be spaced at greater intervals.

F. Weeds and growth other than varieties of grass named in grass seed formula shall be removed. Removal may be accomplished by use of suitable herbicides or by physical removal, in which case top growth and roots shall both be removed, and bare spots exceeding specified limits shall be reseeded.

G. If lawn or grass is established in the fall and maintenance is required to continue into spring months, lawn and grass shall receive an application of lime and fertilizer in the spring. Lime and fertilizer shall be spread in a uniform layer over the entire lawn surface, at the following rates.

Material	Application Rate
Lime	100 lb./1000 sq. ft. [as determined by soil test results]
Fertilizer	20 lb./1000 sq. ft. [as determined by soil test results]

3.09 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

1I. Remove rope barricades only after second cutting of lawns.

C. Remove nondegradable erosion-control measures after grass establishment period.

3.10 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan

END OF SECTION

SECTION 32 9300

TREES, PLANTS, AND GROUND COVERS

PART 1 GENERAL

1.00 RELATED DOCUMENTS

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

1.01 WORK INCLUDED

A. Provide all materials and equipment, and do all work required to complete the planting, as indicated on the Drawings and as specified.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 01 45 00, QUALITY CONTROL; Topsoil and other planting materials testing.
2. Section 31 23 00, SITE EXCAVATING, BACKFILLING AND COMPACTING; Excavation and backfill and establishment of subgrade elevations.
4. Section 32 91 19, LANDSCAPE GRADING.
5. Section 32 92 00, LAWNS AND GRASSES.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern. All standards shall include the latest additions and amendments as of the date of advertisement for bids.

1. American National Standards Institute, Inc. (ANSI):

Z60.1	American Standard for Nursery Stock (Sponsor: American Nursery and Landscape Association)
A 300	American National Standards for Tree Care Operations

2. American Society for Testing and Materials (ASTM):

C 136	Sieve Analysis of Fine and Coarse Aggregates
D 422	Particle-Size Analysis of Soils
E 11	Wire-Cloth Sieves for Testing Purposes
F 405	Corrugated Polyethylene (Pe) Tubing and Fittings

3. "Hortus Third", A Concise Dictionary of Plants Cultivated in the United States and Canada, Cornell University, L.H. Bailey Hortorium, MacMillian Publishing Co., New York, NY.

1.04 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

G. Planting Area: Areas to be planted.

H. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

K. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

L. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

M. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

N. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.05 SUBMITTALS

A. Samples: The following samples shall be submitted:

Material	Sample Size or Quantity

B. Manufacturer's Product Data: Manufacturer's product data and manufacturer's application instructions specific to the Project shall be submitted for the following materials:

Aluminum sulfate
Antidessicant
Fertilizer
Fungicide
Herbicide
Insecticide
Compost
Tree wrap

C. Plant Photographs: Include color photographs in [digital] [3- by 5-inch (76- by 127-mm) print] format of each required species and size of plant material as it will be furnished to the Project.

1. Take photographs from an angle depicting true size and condition of the typical plant to be furnished.
2. Include a scale rod or other measuring device in each photograph.
3. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

D. Certificates: Labels from the manufacturer certifying that the product meets the specified requirements shall be submitted for the following materials:

Commercial fertilizer
Limestone
Compost

E. Test Reports: Test reports from an approved testing agency indicating compliance with the specifications shall be submitted for topsoil and any other materials designated by the Architect.

1.06 OWNER'S INSPECTION AND TESTING

A. Work will be subject to inspection at all times by the Architect. The Owner reserves the right to engage an independent testing laboratory in accordance with requirements of Section 01 40 00 QUALITY REQUIREMENTS to analyze and test materials used in the construction of the work. Where directed by the Architect, the testing laboratory will make material analyses and will report to the Architect whether materials conform to the requirements of this specification.

1. Cost of tests and material analyses made by the testing laboratory will be borne by the Owner when they indicate compliance with the specification, and by the Contractor when they indicate non-compliance.
2. Testing equipment will be provided by and tests performed by the testing laboratory.

1.07 CONTRACTOR'S INSPECTION AND TESTING

A. The Contractor shall engage an independent testing agency, experienced in the testing of agricultural soils and acceptable to the Architect, to perform the topsoil/planting soil tests and analyses specified herein. All costs associated with testing shall be the Contractor's responsibility.

1. Particle size analyis shall include the following gradient of mineral content:

USDA Designation	Size in mm
Gravel	+ 2 mm
Very coarse sand	1-2 mm
Coarse sand	0.5-1 mm
Medium sand	0.25-0.5 mm
Fine sand	0.1-0.25 mm
Very fine sand	0.05-0.1 mm
Silt	0.002-0.05 mm
Clay	< 0.002 mm

2. Chemical analysis shall include the following:
   a. pH and buffer pH
   b. percentage of organic content by oven-dried weight
   c. Nutrient levels by parts per million, including phosphorus, potassium, magnesium, manganese, iron, zinc, and calcium. Nutrient test shall include testing laboratory recommendations for supplemental additions to the soil, if necessary, based on the requirements for ornamental horticultural plants. Recommendations shall include rates at which additives are to be applied.
   d. Soluble salt by electrical conductivity of a 1:2 soil/water sample.

1.08 SOURCE QUALITY CONTROL

A. Identification of plant names shall be as listed in "Hortus Third".

B. Selection of Plant Materials: Submit to the Architect the names and locations of nurseries and/or re-wholesalers or distributors proposed as sources of acceptable plant material. Inspect all plant materials to determine that they meet the requirements of this section. Proposed materials shall be flagged at the nurseries by the Contractor prior to viewing by the Architect.

1. Schedule with the Architect a time for viewing plant material at the nursery and/or re-wholesaler or distributor facilities. Trips shall be efficiently arranged to allow Architect to maximize viewing time. A minimum of four weeks shall be allowed for this viewing prior to time that plants are to be transported to the project site.
2. Architect may choose to attach a seal to each plant, or representative samples.
1. If requested by the Architect, photographs of plant material or representative samples of plants shall be submitted by the Contractor.
4. If re-wholesalers or distributors are proposed as sources of plant material, the Contractor shall supply the Architect with names and locations of nurseries from which plants were obtained.

5. Viewing and/or sealing of plant materials by the Architect prior to shipping does not preclude the Architect's right to reject material for non-conformance to specifications at the site of planting.

1.09 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants. Installer shall provide evidence of the following credentials:

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

1. Certified Landscape Technician - Exterior, with installation and maintenance specialty area(s), designated CLT-Exterior.
2. Certified Landscape Technician - Interior, designated CLT-Interior.
3. Certified Ornamental Landscape Professional, designated COLP.

C. Pesticide Applicator: State licensed, commercial.

D. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

1.10 PLANT MATERIAL QUANTITIES

A. In the event of a discrepancy in plant material quantities between the Drawings and the Plant List(s), the larger quantity shall be required.

1.11 UNAVAILABILITY OF PLANT MATERIALS

A. Before changes or substitutions can be made due to unavailability of plant material, submit satisfactory evidence that the Contractor has advertised for a one month period in a trade journal such as the "American Nurseryman", (Tel. 312-427-7339 and Fax: 312-427-7346), with no response, or has undertaken other methods of locating plant material acceptable to the Landscape Architect.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Transportation of Plant Material: Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants. Trees shall not be transported when daytime air temperatures are below 20°.

1. Plants shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.

2. Unless otherwise authorized by the Architect, notify the Architect at least two working days in advance of the anticipated delivery date of any plant material. A legible copy of the bill of lading, showing the quantities, kinds, and sizes of materials included for each shipment shall be furnished to the Architect, if requested.

B. Storage: Unless specific authorization is obtained from the Architect, unprotected plants shall not remain on the site of work longer than three days prior to being planted.

1. Plants that are not planted immediately shall be protected as follows:

   a. Earth balls shall be kept moist, not be allowed to freeze, and their solidity carefully preserved.
2. Bareroot plants may remain on the site of the work only 24 hours before being planted or placed in storage. During this 24 hour period, prevent injury and desiccation of plants on-site.
   a. Roots of plants in storage shall first be puddled in a paste solution of prepared planting soil and then watered.
   b. Plants shall then be protected and kept moist by "heeling-in" the roots or by placing the plant in a cool moist storage building. The "heeling-in" procedure shall require the plants to be separated and the roots heeled in a suitable moist soil. If plants are stored in a building, the roots shall be covered with a suitable moist mulch.
3. Both the duration and method of storage of plant materials shall be subject to the approval of the Architect.

C. Handling of Plant Materials: Exercise care in handling plant materials to avoid damage or stress.

1.13 REJECTION OF MATERIALS

A. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage, shall be cause for rejection.

B. Upon arrival at the temporary storage location or the site of the work, plants shall be inspected for proper shipping procedures. Plants with roots dried out, large branches broken, balls of earth broken or loosened, or areas of bark torn shall be subject to rejection by the Architect.

C. Rejected plants shall be removed from the area of work and replaced with same species of the required size and quality.

1.14 DIGGING/PLANTING SEASONS

A. Spring Digging: Spring digging of plant materials may commence as soon as the ground has thawed and weather conditions make it practicable to dig at the nursery.

1. Deciduous plants shall not be dug after they have leafed out.
2. Broadleaf evergreens and conifers shall not be dug after new growth or candle push is visible.

B. Fall Digging: Fall digging of plant materials may commence after dormancy has begun and shall continue until such time as the ground has frozen or weather conditions make it impractical to work.

1. Fall digging hazards shall conform to American National Standards Institute, Inc. (ANSI) species and guidelines.

C. Planting Seasons: Planting shall only be performed when weather and soil conditions are suitable for planting the material specified, in accordance with locally accepted practice, approval of the Architect, and to maintain the Contractor's guarantee.

1.15 ACCEPTANCE FOR SUBSTANTIAL COMPLETION

A. The Architect shall inspect all work of this Section for Acceptance for Substantial Completion upon receipt of written notice of completion by the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.

B. Acceptance of plant material by the Architect shall be for general conformance to specified size, character, and quality, and shall not diminish responsibility for full conformance to the Contract Documents.

C. Upon completion and reinspection of all repairs or renewals necessary in the judgement of the Architect, the Architect shall recommend that Acceptance for Substantial Completion of the work of this Section be given by the Owner.

D. Acceptance in Part

1. The work may be Accepted in parts when it is deemed to be in the Owner's best interest to do so, and when permission is given to the Contractor in writing to complete the work in parts.
2. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

1.16 MAINTENANCE

A. The Contractor shall maintain plant material until the completion of the guarantee period and Final Acceptance of work, as described in paragraph 1.15 of this Section.

1.17 GUARANTEE

A. Plants shall be guaranteed for a period of one year after the date of Acceptance by the Owner.

1. When the work is Accepted in parts, the guarantee periods shall extend from each of the partial Acceptances to the terminal date of the last guarantee period. Thus, all guarantee periods terminate at one time.

B. Plants shall be healthy, free of pests and disease, and in flourishing condition at the end of the guarantee period. Plants shall be free of dead and dying branches and branch tips, and shall bear foliage of normal density, size, and color.

C. Replace dead plants and all plants not in a vigorous, thriving condition, as determined by the Architect during and at the end of the guarantee period, without cost to the Owner, as soon as weather conditions permit and within the specified planting period.

1. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this Specification.
2. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.
3. The guarantee of all replacement plants shall extend for an additional one year period from the date of their Acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended guarantee period, the Owner may elect one more replacement or credit for each item.

D. At the end of the guarantee period, and no less than five days prior to final inspection, staking and guying materials, and tree wrap and ties shall be removed from the site.

1.18 FINAL INSPECTION AND FINAL ACCEPTANCE

A. At the end of the guarantee period, the Architect shall, upon receipt of written notice of end of guarantee period, inspect the work for Final Acceptance. Request shall be received at least ten calendar days before the anticipated date for Final Inspection.

B. Upon completion and reinspection of full repairs or replacements necessary in the judgment of the Architect at that time, the Architect shall recommend to the Owner that Final Acceptance of the work of this Section be given.

1.19 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Architect / Construction Manager, and Owner no fewer than three days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without Architect's, Construction Manager's, and Owner's written permission.

C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: May - June
2. Fall Planting: Sept - October

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

PART 2 PRODUCTS

2.01 PLANTS

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on

Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and/or budded, and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement. Plants shall have outstanding symmetrical form; heavily branched with an even branch distribution and a strong, straight, distinct leader where this is characteristic of species. Plants shall possess a normal balance for the species between height and spread. The Architect will be the final arbiter of acceptability of plant form.

1. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
2. Small Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1.
3. Multistem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1.
4. Deciduous Shrubs: Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
5. Coniferous Evergreens: Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

C. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

D. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

E. Plants shall meet the sizes indicated on the Plant List. Plants larger or smaller than specified may be used only if accepted in writing by the Architect.

F. Where a size or caliper range is stated, at least 50% of the material shall be closer in size to the top of the range stated.

G. Plants shall not be pruned before delivery.

H. Plants indicated as "B&B" shall be balled and burlapped.

1. Unless otherwise permitted by the Architect, plants shall be nursery grown.
2 Plants shall be grown for at least two years under climatic conditions similar to those in the locality of the Project.
3. Nursery grown plants shall be dug in the current planting season. No heeled in plants or plants from cold storage that were dug in the previous season shall be accepted.

I. Container grown plants shall be well rooted and established in the container in which they were grown. They shall have grown in the container for a sufficient length of time for the root system to hold the planting medium when taken from the container, but not long enough to become root bound. Container grown plants exceeding the sizes indicated in ANSI Z60.1 shall have containers which are not less than 75% of the ball sizes for comparable B&B plant material. Each container plant shall be inspected and circling roots loosened or pruned as needed.

J. Canes or Trunk(s) and Branches:

1. Very well formed and sturdy with distinct leader and no crotches that may interfere with growth of leader. Trees with included bark in crotches shall be avoided.
2. Branching well spaced and uniformly distributed both vertically and around the circumference to form a well balanced plant.
3. Scars shall be free of rot and not exceed ¼ the diameter of the wood beneath in greatest dimension unless completely healed (except pruning scars).
4. Pruning scars clean cut leaving little or no protrusion from the trunk or branch.
5. Graft union completely healed.
6. No mechanical or pest damage.
7. No extreme succulence.
8. Evidence of adequate twig growth in the past 2-4 years, and well-formed buds.

K. Foliage:

1. Densely supplied with healthy, vigorous leaves of normal size, shape, color and texture (except shrubs moved bare-root or deciduous shrubs when dormant).
2. One half of the foliage should be growing on the lower 2/3 of the trunk.
3. No chlorosis.
4. No more than 5% of total foliage affected by pest or mechanical damage.

L. Root System:

1. Sturdily established and evenly distributed.
2. Container grown plants shall be well developed and hold the soil ball together when removed from the container.
3. Container grown plants shall not be excessively rootbound (except if deliberately grown rootbound to produce a dwarf plant).

2.02 GROUND COVER PLANTS AND VINES

A. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.03 BULBS

A. Bulbs shall be of sizes suitable for outdoor bedding purposes. Both grade names and sizes shall be as indicated on the Drawings and/or Plant List(s).

2.04 PLANTING SOIL

A. Existing Topsoil

1. Existing topsoil from on-site source(s) may be used for planting soil, to the extent available, if it meets the requirements of this Section for planting soil, or if approved by the Architect.

B. Planting Soil

1. Planting soil shall be composed of a natural, fertile, friable soil typical of cultivated topsoils of the locality, suitable for the germination of seeds and support of vegetative growth, with additives, if required, to achieve particle distribution and organic content specifications . Topsoil shall be taken from a well-drained, arable site, free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots, other objectionable, extraneous matter or debris nor contain toxic substances. Planting soil shall have a pH value between 5.5 and 6.5 and organic matter content of 5 to 10% of total dry weight.
2. Planting soil shall have the following mechanical analysis (see paragraph 1.07 for particle sizes):

Approximate Particle Distribution	
Gravel	Less than 10%
Coarse to medium sand	55 – 65%
Fine to very fine sand	15 – 25%
Silt	10– 20%
Clay	15 – 20%

3. Minimum planting soil nutrient levels shall be: Nitrogen @ 5% average of organic matter, Phosphorus @ .02 to .05% average of total soil content, Potassium @ 1.2% average of total soil content.
4. The Contractor shall provide the Architect with planting soil test results, as specified in Paragraph 1.06, before the start of planting operations. If planting soil does not fall within the required particle distribution, organic content, or pH range, it shall be adjusted to meet the specifications through the addition of sand, compost, limestone, or aluminum sulfate to bring it within the specified limits.
5. Planting soil for ericaceous shrubs shall have a pH value range of 4.5 to 5.0.

2.05 COMPOST

A. Compost shall be derived from organic wastes such as food and agricultural residues, animal manures, mixed solid waste and biosolids (treated sewage sludge) that meet all State Environmental Agency requirements. Pine bark shall be carbon source. The product shall be well composted, free of viable weed seeds and contain material of a generally humus nature capable of sustaining growth of vegetation, with no materials toxic to plant growth.
1. Minimum thermophillic bioreduction time of four months with aeration based on temperature monitoring. Compost must be under cover during a minimum curing time of four weeks.
2. Thermophillic temperatures must be sustained at or above 150 dgrees F. for eight weeks for weed seed and pathogen sterilization.
3. Finished compost shall be screened to minus ½ in., protected from any outside contaminants during and after screening and curing.
4. Finished compost shall fall below the following limits:

Ammonium (NH4-N)	0 PPM
Magnesium (Mg)	70 PPM
Iron (Fe)	3.8 PPM
Manganese (Mn)	1.0 PPM
Copper (Cn)	.10 PPM
Zinc (Zn)	.15 PPM
Soluble salts	5.50 mmho/cm

pH shall fall between 6.0 and 7.0

B. Pine Bark Humus: shall be aged and fully decomposed pine bark humus screened to minus ½ in. Screened bark humus shall fall below the following limits:

Ammonium (NH4-N)	20 PPM
Magnesium (Mg)	5.0 PPM
Iron (Fe)	8.0 PPM
Manganese (Mn)	1.0 PPM
Copper (Cn)	.10 PPM
Zinc (Zn)	.15 PPM
Soluble salts	0.50 mmho/cm

pH shall fall between 4.0 and 7.0

2.06 LIMESTONE

A. Limestone shall be an approved agricultural limestone containing no less than 50% of total carbonates, and 25% total magnesium with a neutralizing value of at least 100%. The material shall be ground to such a fineness that 40% will pass through a No. 100 U.S. Standard Sieve, and 98% will pass through a No. 20 U.S. Standard Sieve. The lime shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any lime which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.

2.07 ALUMINUM SULFATE

A. Aluminum sulfate shall be unadulterated and shall be delivered in containers with the name of the material and manufacturer and net weight of contents.

2.08 WATER

A. Water shall be suitable for irrigation and shall be free from ingredients harmful to plant life.

2.09 FERTILIZER

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency. Manufacturer’s literature shall be submitted for approval.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.10 LIQUID BIOLOGICAL AMENDMENTS (IN LIEU OF FERTILIZER)

A. Liquid Biological Amendments standards:

1. Desired Levels Of Organisms (Direct Microscopy)
    - 10 to 150 or more µg active bacteria /ml.

- 150 µg to 300 or more µg total bacteria /ml compost tea 2 to 10 µg or more active fungi /ml.
- 5 to 20 or more µg total fungal biomass/ml.
- 2,000 or more protozoa 1,000 or more flagellates 1,000 or more amoebae 10 – 30 ciliates.
- 2 to 10 BENEFICIAL nematodes/ ml (desired; typically lacking in tea) 1 - 5 bacterial-feeders up to 5 fungal-feeders 1 - 5 predatory nematodes (typically lacking in tea) No root-feeding nematodes.

2. Minimum of 10% active bacteria and fungi
3. Protozoa Inoculums:
   - 4,000 or more protozoa/ml. 2,500 or more flagellates, 1,500 or more amoebae 10-30 ciliates.
4. Nematode extractions:
   - 24-32 beneficial nematodes/ml. 10-12 bacterial-feeders, 7-10 fungal feeders and 7-10 predatory nematodes.
5. Mychorrizal Spores:
   - 9 Species Endo (31,200 prop/lb).
   - 11 Species Ecto (1.5 billion prop/lb)

2.11 SUPERPHOSPHATE

A. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes, and containing not less than 20% available phosphoric acid. The superphosphate shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any superphosphate which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.

2.12 MULCH

A. Mulch shall be a 100% fine-shredded pine bark, of uniform size and free from rot, leaves, twigs, debris, stones, or any material harmful to plant growth. Bark shall have been shredded and stockpiled no less than six months and no more than two years before use. No chunks 3 in. or more in size, and thicker than 1/4 in. shall be left on site.

1. The production shall be fired with coal, using no waste or toxic fuels.
2. The material shall be ceramic, 100% inert and completely inorganic.
3. Material shall be capable of being blended with other soil amendments.
4. Material shall not compress, decompose, or react with agricultural or horticultural chemicals.
5. Material shall be fully calcined, highly predictable, consistent, and stable over time under varying soil conditions.
6. Material shall provide excellent aeration in the soil mix.

B. All lightweight aggregate shall be produced by the rotary kiln process and shall meet all the requirements of ASTM 330 (AASHTO M195). ASTM certification, verified by an independent testing laboratory within 2 years, shall be submitted to the architect/engineer at least 60 days prior to the start of the project. Concrete made from the aggregate with a cement content of 564 pcy (334 kg/m3) and approximately 6% air content shall have a minimum durability factor of 85% when tested in accordance with ASTM C 666.

2.13 GUYING AND STAKING MATERIALS

A. Wood Stakes: Straight, sound, rough sawn lumber 2 in. x 2 in., if square, or 2-1/2 in. diameter, if round. Stakes shall be stained dark green. Wire for staking shall be 12 gauge steel.

B. Wires and Cables

1. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.
2. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
3. Guy Cables: Five-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated [turnbuckles] [compression springs], a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.
4. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

C. Turnbuckles: ¼" x 73/4" Galvanized steel with a 21/2" in. lengthwise opening fitted with eyebolts, as manufactured by Crown Bolt Inc., or approved equal.

D. Hose: High quality braided rubber hose, 3/4 in. diameter and suitable length, black in color.

E. Strapping: Arbortie, manufactured by DeepRoot Green Infrastructure, LLC, 530 Washington Street, San Francisco, CA 94111Tel: 800 458 7668 or 415 781 9700; Fax: 800 277 7668 or 415 781 0191, or approved equal.

2.14 WRAPPING MATERIAL

A. Tree wrapping material shall be equal to the following:

1. Osnaburg Cloth, 4-7/8 in. wide, unbleached, pinked on both edges, manufactured by The Carnegie Textile Co., 1734 Ivanhoe Road, P.O. Box 10276, Cleveland, OH 44110.

2.15 ANTIDESICCANT

A. Antidessicant shall be an emulsion specifically manufactured for plant protection which provides a protective film over plant surfaces which is permeable enough to permit transpiration. Antidessicant shall be delivered in manufacturer's sealed containers and shall contain manufacturer's printed instructions for use.

B. Antidessicant shall be equal to the following:

Product	Manufacturer
Wilt-Pruf	Wilt-Pruf Products, Inc. P.O. Box 469 Essex, CT 06426
Winter Shield	Rockland Corporation

2.16 FUNGICIDE

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

A. Fungicide shall be LESCO Mancozeb DG, #022033, sprayable broad-spectrum fungicide, manufactured by LESCO, Inc.,1301 East 9th Street, Cleveland, OH 44114-1849, or approved equal..

2.17 INSECTICIDE

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Insecticide shall be LESCO Horticultural Oil spray, for control of insects and mites, manufactured by LESCO, Inc.,1301 East 9th Street, Cleveland, OH 44114-1849, or approved equal.

2.18 POST-EMERGENT HERBICIDE

A. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.19 PRE-EMERGENT HERBICIDE

A. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

2.20 STEEL EDGING

A. Steel edging shall be Border Concepts Edging, "Border King", manufactured by Border Concepts, Inc., P.O. Box 471185, Charlotte, NC 28247 or approved equal. Steel edging shall be shop fabricated, primed and painted black.

1. Steel edging shall have slotted holes for staking steel edging every 30 in. o.c.
2. Steel stakes shall be 15 in. long, tapered.
3. Provide manufacturer's end stake and splicer unit.
4. Provide manufacturer's optional preformed tree rings and tree squares as indicated on the Drawings.
5. Provide manufacturer's standard touch-up paint for in field touch-up of scratched or marred areas..

2.21 CRUSHED STONE

A. Crushed stone fill for tree pit drainage shall consist of washed, durable, crushed rock free from fine sand, slit, or rock flour. Gradation shall conform to the following:

Sieve Size	% Passing by Weight
3/4 in.	100
1/2 in.	90-100
3/8 in.	40-70
No. 4	0-15
No. 8	0-5

2.22 DEER PROTECTION

A. Deer control netting may be used at the Owner's and Architect's direction, to protect conifer tree plantings and shrub plantings during the course of the Work.

B. Hardware cloth tree enclosures shall be 23 gauge, 1/4 in. galvanized steel mesh, 4 ft. high.

C. Fasteners for hardware cloth shall be non-corrosive metal ties or galvanized wire.

D. Deer Netting: Deer control netting shall be "C-Flex", concrete reinforcement fabric manufactured by Tenax, supplied by Metro Milorganite, Inc., Bedford Hills, NY 10507; Tel: (914) 666-3171, or approved equal.

1. C-Flex fabric shall be supplied in 6 ft. wide rolls.
2. Wood Stakes for Deer Netting: Straight, sound, rough sawn lumber not less than 2 in. x 2 in., if square, or 2-1/2 in. diameter, if round x 8 ft. long.

PART 3 EXECUTION

3.01 PREPARATION OF PLANT MATERIALS

A. Immediately before digging and following consultation with the Architect, spray all evergreen or deciduous trees in full leaf with Transplant Biostimulant, applying an adequate film over trunks, branches, twigs and foliage and apply Transplant Biostimulant to the root ball area

B. Dig, and ball and burlap (B&B) plants with firm, natural balls of earth, of depth and diameter not less than that recommended by the American Standard for Nursery stock. Plants moved with a ball will not be accepted if the ball is cracked or broken before or during planting operation. Remove all grass, weeds and accumulated soil resulting from nursery cultivation from the top of the root ball prior to digging so that the original trunk flare shows on top of the root ball.

C. Use only natural burlap and jute twine. Do not use synthetic fibers or wire to ball and burlap root balls. Wire baskets will be acceptable if removed in accordance with these specifications.

D. All plant material in transit or temporary stored shall be covered with burlap or similar covering to keep plants from drying out.

E. Ship and store bare root material in refrigerated trucks and storage areas. Keep roots moist and cool until time of planting.

F. If the construction schedule requires trees over 3 ½” in caliper to be planted in the fall, that are of a species considered to be difficult to transplant in the fall, these trees shall be root pruned the previous spring in the nursery.

1. The Architect will determine tree species to be root pruned.
2. A trench shall be dug around the tree at the limit of the proposed root ball to a minimum depth of 24” and back-filled.
3. A 3” high saucer shall be built around the tree outside the edge of the trench.
4. The tree shall be guyed or braced.
5. The tree shall be watered as necessary through the summer.
6. When the tree is dug in the fall, the digging shall be done using methods that preserve the new root growth growing in the soft soil of the trench.
7. Root pruning, when required, shall be done at no additional cost to the Owner, except for owner pre-purchased trees.

3.02 EXAMINATION OF SUBGRADE

A. Examine subgrade and rough grading before planting. Alert Architect to unacceptable rough grading or subgrade conditions.

3.03 PREPARATION OF SUBGRADE

A. After subgrade levels have been reached and immediately prior to placing planting soils, the entrie subgrade area shall be loosened to a minimum depth of 12 inches utilizing the bucket of a backhoe or equivalent equipment.

B. Any subgrade areas which have become heavily compacted (defined as exceedig 86% - 88% compaction ASTM C698 Standard Proctor) including, but not limited to, temporary parking areas, material stockpile areas, temporary roadways, construction areas, areas shown on the plans, or areas identified by Architect shall be deep-scarified. Immediately prior to placing soils, heavily compacted areas shall be loosened to a minimum depth of 36 inches using the teeth of a backhoe or other suitable equipment. Frequency of compaction tests shall be one per 200 square feet.

C. Using a wide-track bulldozer size D-5 or smaller, compact the scarified subgrade to 86% - 88% compaction ASTM D698 Standard Proctor. Contractor shall provide shovel dug test pits to the full depth of the mitigation, where located per the direction of the Architect, in order for the Architect to review whether the work has been done as required. Backfill the pits after the review(s).

D. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Provide a written report to Architect indicating that subgrade has been placed to the required elevations, has been decompacted according to the Contract Documents and is ready for inspection at least 3 days prior to placing planting soil. Perform no work of placing and spreading planting mixes until elevations have been confirmed and written report has been accepted by the Owner’s Representative.

E. After the soils have been loosened and inspected, topsoil may be spread by using a wide track bulldozer size D-5 or smaller or may be dumped and spreada with bucket of a backhoe from the edge of the loosened area. No rubber-tired equipment or heavy equipmenmt except for small bulldozer shall pass over the subsoils (subgrade) after they have been loosened. If Contractor plans to utlilize such areas for any use of heavy equipment, this should be carried out prior to beginning the process of loosening soils or filling in that area, or it shall be rescarified to meet this specification requirement.

3.04 SOIL DRAINAGE/DETRIMENTAL SOILS

A. Test drainage of five planting pits in locations as directed by the Architect. Pits shall be filled with water twice in succession. The time at which water is put into the pit for a second filling shall be noted. Architect shall then be notified of the time it takes for pit to drain completely. Planting operations shall not proceed until Architect has reviewed test drainage results.

1. To test drainage, dig a whole about 1 foot deep. Fill with water and allow it to drain completely. Immediately refill the pit and measure the depth of the water with a ruler. 15 minutes later, measure the drop in water in inches, and multiply by 4 to calculate how much water drains in an hour.
2. Less than 1 inch per hour is poor drainage, indicating the site may stay wet for periods during the year. Plants that don't tolerate poor drainage will suffer. 1 to 6 inches of

drainage per hour is desirable. Soils that drain faster than 6 inches per hour have excessive drainage, and you should consider choosing plants that tolerate dry conditions and "droughty" soils.

B. The Contractor shall notify the Architect in writing of all soil or drainage conditions that are considered detrimental to growth of plant material. Submit proposal and cost estimate for correction of the conditions for Architect's approval before starting work.

3.05 LAYOUT OF PLANTING AREAS

A. Individual plant locations and outlines of shrub and ground cover areas to be planted shall be staked by the Contractor in ample time to allow inspection by the Architect.

B. Digging shall not begin until locations are approved by the Architect.

C Location of trees shall be staked using color coded stakes. A different stake color shall be used for each tree species.

3.06 PLANT PIT EXCAVATION

A. Planting pits for trees and shrubs shall be excavated to the depth and dimensions indicated on the Drawings.

B. Excavation shall not begin until locations are approved by the Architect.

3.07 STEEL EDGING

A. Steel edging shall be installed at locations indicated on the Drawings. Where required, edging shall be cut square and accurately to required length.

1. Steel edging shall be securely staked in required position. Stakes shall be driven every 30 in. o.c. along length of edging.
2. Adjacent lengths of edging shall be spliced together with manufacturer's standard splicer unit.
3. Edging shall be set plumb and vertical at required line and grade. Straight sections shall not be wavy; curved sections shall be smooth and shall have no kinks or sharp bends.

3.08 SPREADING OF PLANTING SOIL

A. Planting soil shall be spread in lifts not greater than 12 inches and compacted to a density between 82% and 86% Standard Proctor Maximum Dry Density in accordance with ASTM D698. The surface area of each lift, including the subgrade after it has been compressed by a backhoe, shall be scarified by raking prior to placing the next lift.

B. Place and spread planting medium to a depth greater than required such that after settlement, finished grade shall conform to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.

C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over 1 inch diameter and legally dispose of off-site.

D. Surfaces shall be graded and smoothed, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.

3.09 PLANTING

A. Tree, shrub, and groundcover beds shall be excavated to the depth and widths indicated on the Drawings. If the planting pit for any tree is dug too deep, soil shall be added to bring it to correct level, and the soil shall be thoroughly tamped. Walls of plant pits shall be dug so that they are sloped as shown on the Drawings, and scarified. Do not excavate compacted subgrades of adjacent pavement or structures.

B. Plants shall be set as indicated on Drawings. Plants shall be set so that the root flare is at, or slightly above, finished grade. Plants located in poorly drained soils shall be set 2 to 4 inches above finished grade, gradually sloping between the top of the root ball and the surrounding finished grade.

C. Plants shall be turned to the desired orientation when required by Architect.

D. Containerized plants shall be removed from container taking care not to damage roots. The side of the root ball shall be scarified to prevent root-bound condition before positioning in planting pit.

E. Plants shall be positioned in center of planting pits, set plumb, and rigidly braced in position until all planting soil has been tamped solidly around the balls.

F. Pits shall be backfilled with planting soil. Soil shall be worked carefully into voids and pockets, tamping lightly every 6 in.

1. When pit is two-thirds full, plants shall be watered thoroughly, and water left to soak in before proceeding.
2. At this time, ropes or strings on top of balls shall be cut and shall be pulled back. Burlap or cloth wrapping shall be left intact around ball except that portions of wrap that are exposed at top of ball shall be turned under and buried. Non-biodegradable ball wrapping and support wire shall be totally removed from ball and planting pit.
3. Wire baskets shall be completely cut away from sides of root ball, and removed from pit. Bottom of basket may remain.
4. Remove nursery plant identification tags.

G. Backfilling and tamping shall then be finished and a saucer formed around plant pits as indicated on the Drawings.

H. Saucer shall be filled with water and water left to soak in. Saucer shall then be filled with water again.

3.10 BULBS

A. Prepare flowering plant planting bed by application of fertilizers and pH-altering amendments and thoroughly rototilling into the top 12 in. prior to planting bulbs and flowering plants.

B. Bulbs shall be planted at depths and spacing indicated on the Drawings in soil cultivated a minimum depth of 12 in. Fertilizer and bone meal shall be incorporated at this time.

1. After bulbs are placed, cover halfway with planting soil, water thoroughly, then cover completely with planting soil and water again.

3.11 PERENNIALS

A. Set out and space plants 12 inches (300 mm) apart, unless otherwise indicated on the landscape planting plan.

B. Perennials: Dig at least 18" deep, but 12" is adequate. Work 6" humus into the top layers of soil by digging or tilling.

I. Perennials: Check root ball after removing plant from its container. Encircling roots need to be gently loosened from the tight mat of root-bound plants. If roots are very dense at bottom of pot, slice off the bottom 1". If roots are seriously disturbed when planting, cut back some foliage to reduce the water stress that will occur. Plant at the same soil level as the plant was in its container.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 LIQUID BIOLOGICAL AMENDMENTS

A. In all new planting areas, create injection sites made every 2 feet in a grid pattern. If the viable root zone varies from this area, adjust the pattern accordingly. Each injection site shall have a 2-inch wide diameter by 8-inch deep column that will act as leaching fields during the planting process. After the liquid and aeration injection is completed, the injection columns shall be backfilled with a custom blend of long-term granular food sources that include 25% feathermeal, 75% humate plus corresponding mychorrizal spores.

B. Early spring injection for both Ecto and Endo Mychorrizal plants shall consist of 50% concentrated liquid Biological Amendment with 1/2 gallon per a 100 gallons of soluble kelp, humic acid and molasses (or fish hydrolysate).

3.13 FERTILIZER APPLICATION

A. Fertilizer, if required, shall be applied at the rates recommended by soil testing results, as specified in paragraph 2.11.

3.14 FUNGICIDE

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Immediately after planting, all trunks of deciduous trees shall be sprayed with fungicide, applied as directed by chemical manufacturer.

3.15 PRE-EMERGENT-HERBICIDE

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Immediately after planting, pre-emergent herbicide shall be applied to ornamental shrub beds and and around base of trees, in strict accordance with chemical manufacturer's printed instructions.

3.16 POST EMERGENT-HERBICIDE

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Upon the appearance of weeds within planted areas, pre-emergent herbicide shall be applied to ornamental shrub beds and and around base of trees, in strict accordance with chemical manufacturer's printed instructions.

3.17 INSECTICIDE

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Upon the appearance of insect problems, all trunks of deciduous trees shall be sprayed with insecticide, applied as directed by chemical manufacturer.

3.18 WRAPPING

A. Trunks of deciduous trees shall be spiral wrapped to a minimum height of the third branch or two-thirds the height of tree, whichever is higher. Wrap shall be applied from base up so

that layers overlap and shed water. Secure at the top with flexible weatherproof tape, as specified.

B. REVIEW PSU extension Reference “Planting Ornamentals” for more additional information on wrapping standards https://extension.psu.edu/planting-ornamentals

3.19 STAKING AND GUYING

A. Each tree shall be staked or guyed immediately following planting. All evergreen trees and deciduous trees over 4” caliper shall be guyed. Plants shall stand verticle and plumb after staking or guying. Set vertical stakes and space to avoid penetrating root balls or root masses. Allow enough slack to avoid rigid restraint of tree. Stakes and guys shall be installed as indicated on the Drawings.

3.20 MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches (150 mm).

B. Mulch shall be applied as follows (entire area listed shall be mulched):

Plant Type	Mulch Area	Mulch Depth, in.
Tree	Saucer	3
Shrub	Saucer or Bed	3
Ground Cover	Bed	2

Mulch shall not be allowed to cover the base of trunks.

B. Compost mulch shall be uniformly applied within the area(s) indicated on the Drawings at an average depth of 2-3"” Water thoroughly after application to stabilize the mulch. All foreign matter and debris larger than 2” shall be removed from the surface of the mulched area.

3.21 PRUNING

A. Each tree and shrub shall be pruned to preserve the natural character of the plant. Pruning shall be done after delivery of plants and after plants have been inspected and approved by the Architect. Pruning procedures shall be reviewed with Architect before proceeding.

B. Pruning shall be done with clean, sharp tools. Cuts shall be made flush, leaving no stubs. No tree paint shall be used.

C. Dead wood, suckers, and broken, weak, interfering and badly bruised branches shall be removed.

3.22 DEER PROTECTION

A. Install hardware cloth enclosures for all deciduous trees..

B. For trees staked with bamboo stakes, stakes shall be inside of the enclosure, with the stakes on the northwest side of the tree (direction of the prevailing wind).

C. Deer control netting shall be fastened to wood stakes with 3/8 in. heavy gauge staples. Wood stakes shall be buried 2 ft. deep in the ground, with 6 ft. exposed above grade to

receive netting. Size and location of fenced areas shall be determined by the Architect and the Owner.

3.23 MAINTENANCE OF PLANTING

A. Maintenance shall begin immediately after each plant is planted and shall continue until Final Acceptance.

B. Maintenance shall consist of pruning, watering, cultivating, weeding, mulching, fertilizing, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, adjusting and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings free of insects and disease, and in a healthy growing condition. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

C. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

D. Daily watering of 1 gal./caliper inch should be delivered to the root ball of each tree during the first summer after planting. Continue through fall, reducing frequency. For trees larger than 3 inch caliper, fill saucer with 6 – 8 gallons twice per week during hot, dry weather, and once per week during cooler, wetter periods.

E. Planting areas shall be kept free of weeds, grass, and other undesired vegetative growth.

F. Maintenance pruning of pollarded trees shall occur annually during the dormant season to remove branches 1 in. and larger in diameter and thin out sucker growth. Branches to be pruned shall be cut flush to the branch ends established in the initial pollarding. Maintenance pruning shall be done by a qualified arborist and techniques shall conform to NAA standards referenced above. Pollarding shall be reviewed with the Architect before commencing work. Additional light pruning to shape and thin crowns shall be done during the growth season as directed by the Architect.

3.24 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.25 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

3.26 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan.

END OF SECTION

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.

B. Related Requirements:

1. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
2. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.

1.3 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Herbicide.
2. Paving geotextile.
3. Joint sealant.

B. Hot-Mix Asphalt Designs:

1. For each hot-mix asphalt design proposed for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paving-mix manufacturer and testing agency.

B. Material Certificates: Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

1. Aggregates.
2. Asphalt binder.
3. Asphalt cement.
4. Cutback prime coat.
5. Emulsified asphalt prime coat.

6. Tack coat.
7. Fog seal.
8. Undersealing asphalt.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of PennDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
3. Slurry Coat: Comply with weather limitations in ASTM D3910.
4. Asphalt Base Course and Binder Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D242/D242M or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: ASTM D6373 or AASHTO M 320 binder designation PG 58-28.

B. Asphalt Cement: ASTM D3381/D3381M for viscosity-graded material.

C. Tack Coat: ASTM D977 or AASHTO M 140 emulsified asphalt, or ASTM D2397/D2397M or [AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled [**tires**] [**asphalt shingles**] [**or**] [**glass**] from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Sand: ASTM D1073 or AASHTO M 29, Grade No. 2 or No. 3.

C. Joint Sealant: ASTM D6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

1. Surface Course Limit: Recycled content no more than 10 percent by weight.

B. General: Hot-mix asphalt shall be provided in accordance with the specifications set forth in PennDOT Publication 408 (latest addition, as amended). Payment is in accordance with terms of contract. **There is no asphalt escalator associated with this project.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

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

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course and binder course in number of lifts and thicknesses indicated.
2. Spread mix at a minimum temperature of 250 deg F (121 deg C).
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. "Superpave" Gyratory Compactor test method: 96 percent of reference laboratory density in accordance with ASTM D6927 or AASHTO T 245, but not less than 94 percent or greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:

1. Base Course and Binder Course: Plus or minus 1/2 inch (13 mm).

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course and Binder Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.

E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321216

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete paving.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Fiber reinforcement.
3. Admixtures.
4. Curing compounds.
5. Bonding agent or epoxy adhesive.
6. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.6 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

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 design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150/C150M portland cement**.**
2. Fly Ash: ASTM C618, [**Class C**] [**or**] [**Class F**].
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

E. Water: Potable and complying with ASTM C94/C94M.

2.4 FIBER REINFORCEMENT

A. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, 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 C309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch (9.5-mm) sieve and 85 percent retained on a No. 8 (2.36-mm) sieve.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content, 1-1/2-inch (38-mm) Nominal Maximum Aggregate Size: 5-1/2 percent plus or minus 1-1/2 percent.
2. Air Content, 1-inch (25-mm) Nominal Maximum Aggregate Size: 5 percent plus or minus 1-1/2 percent.
3. Air Content, 3/4-inch (19-mm) Nominal Maximum Aggregate Size: 5 percent plus or minus 1-1/2 percent.

C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

D. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m.

E. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Maximum W/C Ratio at Point of Placement: 0.45.
3. Slump Limit: [5 inches (125 mm) plus or minus 1 inch (25 mm).

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 20 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows**:**

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch (10-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch (10-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. 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 (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or 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 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-feet- (3-m-) long; unleveled straightedge not to exceed 1/2 inch (13 mm).
4. Joint Spacing: 3 inches (75 mm).
5. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
6. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

C. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

E. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

F. Concrete paving will be considered defective if it does not pass tests and inspections.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Prepare test and inspection reports.

3.10 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321723 - PAVEMENT MARKINGS

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. Painted markings applied to asphalt paving.

1.3 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Pavement-marking paint, acrylic.

B. Shop Drawings:

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of PennDOT for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.3 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint, Acrylic: Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II, with drying time of less than 45 minutes.

1. Color: White, Blue.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow new asphalt paving or concrete surfaces to age for a minimum of **30** days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Swing gates.

B. Related Requirements:

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 the following:

a. Fence and gate posts, rails, and fittings.
b. Chain-link fabric, reinforcements, and attachments.
c. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of chain-link fence and gate.

B. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.6 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to comply with performance requirements.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Faulty operation of gate hardware.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7:

1. Design Wind Load
a. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire for Fabric: Wire diameter of 0.148 inch (3.76 mm).

a. Mesh Size: 1 .75 inch (44.45 mm)
b. Polymer-Coated Fabric: ASTM F668.

1) Color: Black according to ASTM F934.

3. Selvage: Knuckled at both selvages.

2.3 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:

1. Fence Height: As indicated on Drawings.
2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.
    a. Line Post: As noted.
    b. End, Corner, and Pull Posts: As noted.
3. Horizontal Framework Members: Intermediate, top, and bottom rails according to ASTM F1043.
4. Brace Rails: ASTM F1043.
5. Polymer coating over metallic coating.
    a. Color: Black, according to ASTM F934.

2.4 SWING GATES

A. General: ASTM F900 for gate posts and single and double swing gate types.

1. Gate Leaf Width: As indicated.
2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.

B. Pipe and Tubing:

1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hinges: 180-degree inward/outward swing.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Padlock and Chain: By Owner.
4. Closer: Manufacturer's standard.

2.5 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.

C. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

a. Hot-Dip Galvanized Steel: 0.148-inch- (3.76-mm-) diameter wire

D. Finish:

a. Polymer coating over metallic coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for[**a certified survey of property lines and legal boundaries,**] site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
   a. Concealed Concrete: Place top of concrete 2 inches (50 mm) below grade to allow covering with surface material.
   b. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and

placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet (152 m), space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 10 feet (3 m) o.c.

F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches (1830 mm) or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Intermediate and Bottom Rails: Secure to posts with fittings.

I. Chain-Link Fabric: Apply fabric to outside of enclosing framework (to be confirmed with Architect prior to installation). Leave 2-inch (50-mm) bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches (380 mm) o.c.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 12 inches (610 mm) o.c.

L. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323113

SECTION 331313 - FACILITY SANITARY SEWERS

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. Pipe and fittings.
2. Cleanouts.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Pipes and fittings.
2. Manholes
3. Cleanouts

B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

C. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.5 PROJECT CONDITIONS

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

1. Notify Engineer no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Engineer's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Shielded, Flexible Couplings:

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:

a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.

2. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 CLEANOUTS

A. PVC Cleanouts:

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:

a. Canplas LLC.
b. IPS Corporation.
c. NDS.
d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
e. Sioux Chief Manufacturing Company, Inc.

f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
g. Or approved equal.

2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Provide lid and frame per details.

2.4 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints, and in conformance with Lower Allen Township Authority requirements.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch- minimum-width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.5 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 48-inch minimum cover.
4. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints, and according to the requirements of Lower Allen Township Authority.

3.4 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 22 13 16 "Sanitary Waste and Vent Piping".

B. Make connections to existing manhole per (and in the presence of) Lower Allen Township Authority.

3.7 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water and maintain such pressure without leakage for at least 15 minutes.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 331313

SECTION 331415 - SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water-distribution piping and related components outside the building for domestic water service and terminated 5 ft. (1.5 m) from building.

1.2 DEFINITIONS

A. CDA: Copper Development Association.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:

1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.
2. Protect threaded ends and flange faces against damage.

3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.

B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with standards of authorities having jurisdiction for domestic water-service piping, including materials, installation, testing, and disinfection.

B. Piping materials to bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.

D. All piping and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and service sizes.

B. Potable-water piping and components comply with NSF 14, NSF 61, and NSF 372.

2.3 PE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psig (1100 kPa).

1. Insert Fittings for PE Pipe: ASTM D2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
2. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 160 psig (1100 kPa).

1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 160 psig (1100 kPa).

2.4 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D2466.

2.5 PIPING JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

C. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.7 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
1. Nonrising-Stem, Metal-Seated Gate Valves:
a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
1) Standard: AWWA C500.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

2. Nonrising-Stem, Resilient-Seated Gate Valves:

   a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

3. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:

   a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 250 psig (1725 kPa).
      3) End Connections: Push on or mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

4. OS&Y, Rising-Stem, Metal-Seated Gate Valves:

   a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
      1) Standard: AWWA C500.
      2) Minimum Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Flanged.

5. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

   a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Flanged.

B. Gate Valves - Bronze:

1. Source Limitations: Obtain gate valves - bronze, from single manufacturer.
2. Gate Valves - OS&Y, Rising Stem: Bronze body and bonnet and bronze stem.

   a. Standards: UL listed and FM Global approved.
   b. Minimum Pressure Rating: 175 psig (1207 kPa).
   c. End Connections: Threaded.

3. Gate Valves - Nonrising Stem: Class 125, bronze with solid wedge.

   a. Standard: MSS SP-80.
   b. End Connections: Threaded or solder.
   c. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING APPLICATIONS

A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.

B. Do not use flanges or unions for underground piping.

C. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

D. Underground water-service piping to be the following:

1. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Provide a continuous bare copper or aluminum tracer wire not less than 0.10 inch (2.5 mm) in diameter in sufficient length over each separate run of nonmetallic pipe.

3.4 INSTALLATION OF PIPING

A. Install PVC, AWWA pipe in accordance with ASTM F645 and AWWA M23.

B. Bury piping with depth of cover over top at least 30 inches (750 mm).

C. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

D. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Construct joints with elastomeric seals and lubricant in accordance with ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50 psig (350 kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.7 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.8 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331415

June 25, 2019

HILLIS-CARNES
ENGINEERING SSOCIATES, INC.
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Pennsylvania State University
The 328 Building, Suite 325
University Park, PA 16802

Attention: Mr. J. Douglas Wenger, RLA, LEED AP, DBIA

Re: Geotechnical Engineering Study
PSU Harrisburg Campus
Proposed Soccer Competition and Practice Field Improvement Project
Harrisburg, Pennsylvania
HCEA Project No. R19044

Mr. Wenger:

Hillis-Carnes Engineering Associates, Inc. (HCEA) is pleased to submit this report concerning the subsurface exploration and subsequent geotechnical evaluations for the proposed Soccer Competition and Practice Field Improvement Project on the PSU Harrisburg Campus in Middletown, Pennsylvania. The subsurface exploration program was performed in the area of the proposed expansion of existing SWM Basin 1A and at four (4) proposed light pole locations surrounding the proposed soccer facility. This report summarizes the subsurface soil conditions at the site and provides recommendations for the design and construction of the proposed foundations associated with the proposed construction. These services were provided in general accordance with our proposal dated May 24, 2019.

We wish to advise you that the boring samples will be stored at our Harrisburg, Pennsylvania office for a period of 30 days from the date of this letter. Should you wish the samples to be stored for a longer period of time or to be delivered to you or another party, please advise us in writing prior to the end of the 30-day period. Otherwise, the samples will be discarded at the end of the 30-day storage period.

HCEA appreciates having had the opportunity to provide the geotechnical consultation for this project, and we will remain available for further consultation during the various design stages. Should you have any questions concerning the contents of this report, or require additional consultation, design, inspection, or testing services, please contact our Office.

Very truly yours,
HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

Jerome Guy
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Nathaniel J. Lauver, P.E.
Project Engineer
nlauver@hcea.com

HILLIS-CARNES
ENGINEERING ASSOCIATES, INC.

Geotechnical Engineering Study
PSU Harrisburg Campus
Proposed Soccer Competition and Practice Field Improvement Project
Harrisburg, Pennsylvania
HCEA Project No. R19044

Prepared For:

Pennsylvania State University
The 328 Building, Suite 325
University Park, PA 16802

Prepared By:

Hillis-Carnes Engineering Associates, Inc.
3110 Pike Street
Harrisburg, PA 17111

Date:

June 25, 2019

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the boring locations and to evaluate those conditions with respect to the proposed construction.

The evaluations and recommendations presented in this study were developed from a review of the project information provided and an interpretation of the general subsurface conditions at the site based on the results of the site exploration. An evaluation of the site with respect to potential construction problems and recommendations dealing with the earthwork and inspection during construction is also included. The inspection is considered necessary to confirm that the subsurface conditions are consistent with those identified during the geotechnical study and to document that the soils-related construction activities are performed properly.

2.0 PROJECT CHARACTERISTICS

The project site is located on the Pennsylvania State University Harrisburg Campus in Middletown, Pennsylvania. The proposed project is located to the west of College Avenue just north of the College Avenue/Olmstead Drive intersection and south of the existing Educational Activities Building South as shown on Figure 1 - Project Location Map and Figure 2 – Aerial Location Map in the Appendix.

Based on available site plans, it is understood that the proposed project will include expansion of the existing Stormwater Basin (SWM) 1A to the north, construction of a lighted soccer competition and practice field, and construction of a future parking lot between the proposed soccer field and the existing Educational Activities Building South. As requested, an exploration program was performed in the area of the proposed expansion of existing SWM Basin 1A and at four (4) proposed light pole locations surrounding the proposed soccer facility as shown on Figure 3 – Boring Location Plan.

Available plans indicate a bottom of pond elevation of El. 330 feet for the expansion of SWM Basin 1A. Based on existing ground elevations at the boring locations, cut ranging from 20 to 25 feet will be required to establish the bottom of the facility. It is anticipated that minimal cuts and fills (on the order of 3 feet or less) will be required to establish the proposed finished grade elevations at the proposed light pole bases adjacent to the soccer facility.

Should any of the project characteristics, construction type, or structural loading conditions differ from those outlined above, then this office should be contacted so revisions of these recommendations can be made.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 Standard Penetration Test Borings

To determine the general subsurface conditions at the site, a subsurface exploration program was performed consisting of a total of seven (7) Standard Penetration Test (SPT) soil borings designated as Boring B-1 through Boring B-7. Borings B-1 through B-3 were drilled in the area of the proposed expansion of SWM Basin 1A to evaluate the subsurface conditions in regard to the excavation required to establish the bottom of the expanded facility. Borings B-4 through B-7 were drilled at the proposed location of four (4) of four light pole bases surrounding the proposed soccer facility. Boring B-4 was drilled at the base of proposed Light Pole S1, while Boring B-5 was drilled at the base of

proposed Light Pole S2. Similarly, Boring B-6 was drilled at the base of proposed Light Pole S3, while Boring B-7 was drilled at the base of proposed Light Pole S4. Boring locations are shown on Figure 3 – Boring Location Plan included in the Appendix.

The test borings were extended to depths ranging from 13.0 feet to 25.0 feet. All borings were advanced using hollow stem augers to their desired depths or to the apparent top of bedrock which is indicated at depths at which auger refusal was obtained. Ten feet of rock coring was conducted with Boring B-3 in order to advance the boring to the planned bottom of basin elevation. Depths to the top of bedrock ranged from 13.0 in Boring B-6 feet to 21.5 feet in Boring B-2 below existing grade as indicated below. A brief overall summary of the boring results is presented in tabular form below.

Summary of Boring Data

Boring Designation	Drilled Depth (Feet)	Depth to Bedrock (Feet)	Groundwater Levels	
			Depth Upon Completion (Feet)	Depth After 24 Hours (Feet)
SWM Basin 1A Expansion – Proposed Bottom of Basin El. 330 feet				
B-1	20.0 (El. 328.7)	Auger Refusal Obtained at 20.0 feet (El. 328.7)	Dry	Borehole Backfilled Upon Completion
B-2	21.5 (El. 329.6)	Auger Refusal Obtained at 21.5 feet (El. 329.6)	Dry	Borehole Backfilled Upon Completion
B-3	25.0 (El. 328.7)	Bedrock Cored at 15.0 feet (El. 338.7)	Dry	Borehole Backfilled Upon Completion
Proposed Light Pole Borings – Light Poles S1, S2, S3, and S4				
B-4	19.5 (El. 339.4)	Spoon Refusal Encountered at 19.5 feet (El. 339.4)	Dry	Borehole Backfilled Upon Completion
B-5	20.0 (El. 340.0)	Bedrock Not Encountered	17.5	Borehole Backfilled Upon Completion
B-6	13.0 (El. 346.7)	Auger Refusal Obtained at 13.0 feet (El. 346.7)	Dry	Borehole Backfilled Upon Completion
B-7	18.0 (El. 338.4)	Auger Refusal Obtained at 18.0 feet (El. 338.4)	Dry	Borehole Backfilled Upon Completion

Negley's Drilling performed the test borings on June 4, 2019, with an Acker XLS track-mounted drill rig equipped with an automatic hammer. HCEA provided full-time boring inspection during drilling operations. The borings were advanced with hollow-stem augers and the subsurface soils were sampled continuously to a depth of 10 feet and at 5-foot sample intervals thereafter until the depths at which the boreholes encountered bedrock or were terminated. Samples were taken by driving a 1-3/8 inch I.D. (2-inch O.D.) split-spoon sampler in accordance with ASTM D1586 specifications. The sampler was first seated 6 inches to penetrate any loose cuttings and then was driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the middle 12 inches of the 2-foot spoon is designated as the "Penetration Resistance" or "N" value. The penetration resistance is an index to the soil strength and compression characteristics.

Bedrock was obtained by diamond core drilling in general accordance with the procedures in ASTM D2113 "Standard Method for Diamond Core Drilling for Site Investigation. In-situ quality of bedrock was determined by physical observation of the core retrieved (hardness, degree of weathering, fracture spacing, etc.) as well as calculation of the Rock Quality Designation (RQD) of the recovered core. RQD is a qualitative index used to identify the relative quality of the rock mass. It is a

percentage calculated by summing the lengths of intact pieces of rock core which exceed 4 inches in length and dividing that length by the total length of the core run.

At completion of the drilling, the boreholes were backfilled with the auger cuttings. Upon backfilling of the boreholes, no additional compaction effort or site restoration was performed. Additional settlement and/or softening of the soil replaced in the boreholes may occur, resulting in a depression or hole in the ground surface. Consequently, future maintenance or restoration of the site may be required by others.

During drilling operations, HCEA performed boring inspection and prepared field logs for each of the borings. Portions of each SPT soil sample were placed in air-tight glass jars and rock cores were placed in wooden core storage boxes. After completion of the drilling, the samples were transported to HCEA's laboratory for future examination. In the laboratory, the samples were visually reviewed by the Geotechnical Engineer to review the inspector's field classifications. The samples were classified in accordance with the Unified Soil Classification System (USCS) and the field classifications were revised where necessary. The USCS classifications appear on the typed Records of Exploration.

The Records of Exploration, included in the Appendix, show subsurface sample depths and recoveries, SPT results, RQD values, and water level measurement data. The logs also show the approximate thickness, location, and visual classification of each material encountered. The stratigraphic lines separating each material type represent the approximate location of the boundary between them. The transition between materials may be far more or less gradual than indicated on the logs.

3.2 Laboratory Testing

Laboratory testing was performed in HCEA's laboratory on representative samples obtained from the field exploration for basic engineering properties. Laboratory testing consisted of Particle Size Analysis (ASTM D442), Atterberg Limits (ASTM D4318), and Natural Moisture Content (ASTM D2216). The Unified Soil Classification System (USCS) was used to assign group symbols and group names to the soils tested. The results of the laboratory testing are summarized below. The Particle Size Distribution Reports from the laboratory testing are also included in the Appendix of this study.

Summary of Laboratory Testing Results									
Boring and Sample Numbers	Depth (Feet)	USCS Classification	USCS Symbols [1]	As-Received Moisture Content (%)	Atterberg Limits		Grain Size		
					Liquid Limit	Plasticity Index	%Gravel	%Sand	%Fines
B-1 S-5	8.0 – 10.0	Silty SAND	sm	13.6	--	--	--	--	--
B-1 S-6	13.0 – 14.5	Silty SAND	sm	13.1	--	--	--	--	--
B-2 S-5	8.0 – 10.0	Clayey SAND with Gravel	sc	18.7	--	--	--	--	--
B-2 S-6	13.0 – 13.9	Clayey SAND with Gravel	sc	17.8	--	--	--	--	--
B-2 S-7	18.0 – 20.0	Silty SAND	sm	10.5	--	--	--	--	--
B-3 S-3	4.0 - 6.0	Silty CLAY with Sand	cl-ml	10.7	--	--	--	--	--
B-3 S-6	13.0 – 14.3	Silty SAND	sm	10.3	--	--	--	--	--
B-4 S-4	6.0 – 8.0	Silty SAND	sm	20.0	--	--	--	--	--
B-4 S-6	13.0 – 15.0	Silty SAND	sm	15.3	--	--	--	--	--
B-5 S-6	13.0 – 15.0	Silty GRAVEL with Sand	GM [1]	10.1	Non-plastic		44.9	41.5	13.6
B-5 S-7	18.0 – 20.0	Silty SAND	sm	15.3	--	--	--	--	--
B-6 S-4	6.0 – 8.0	Well-graded GRAVEL with Sand	gw	10.4	--	--	--	--	--
B-6 S-5	8.0 – 10.0	Well-graded GRAVEL with Sand	gw	8.5	--	--	--	--	--
B-7 S-5	8.0 – 10.0	Silty SAND	SM [1]	15.3	Non-plastic		0.2	52.4	47.4
B-7 S-6	13.0 – 15.0	Silty SAND	sm	13.3	--	--	--	--	--

NOTE [1]: Lower care USCS symbol denotes that the sample was visually classified while an upper case classification denotes that the sample was laboratory classified.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered at the site are shown on the Records of Soil Exploration and included in the Appendix. A summary of the test boring results and brief description of the subsurface conditions and pertinent engineering characteristics of the soils are given below.

Strata divisions shown on the Records of Soil Exploration have been estimated based on visual examinations of the recovered boring samples. In the field, strata changes could occur gradually and/or at slightly different levels than indicated. Groundwater conditions indicated on the Records of Soil Exploration are those observed during the period of the subsurface exploration. Fluctuations in groundwater levels could occur seasonally and might also be influenced by changes in grading, runoff and infiltration rates, and other influencing factors.

Generalized subsurface conditions based on the results of the test borings are discussed below.

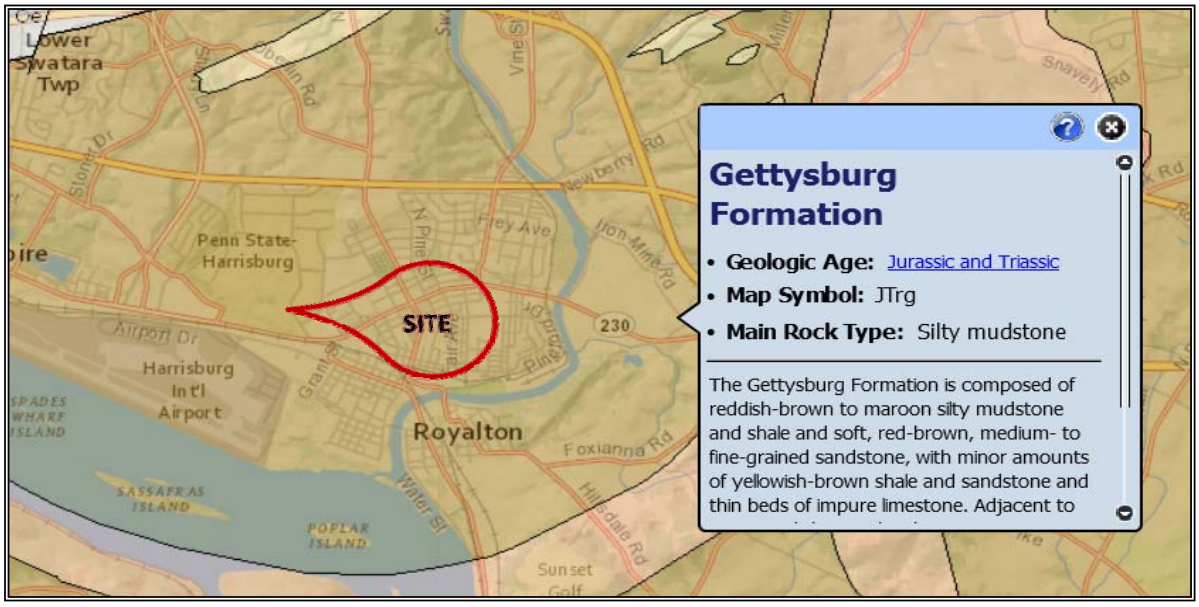
4.1 General Site Geology

Available geologic maps indicate that the project site is located within the Jurassic and Triassic-aged Gettysburg Formation (JTrg). The bedrock of the Gettysburg Formation is described as reddish-brown to maroon silty mudstone and shale and soft, reddish-brown medium to fine-grained sandstone. Minor amounts of yellowish-brown shale and sandstone and thin beds of impure limestone are common.

The rock is generally described as well bedded and most bedding is described as thin to flaggy. Most joints have a blocky pattern. Fractures are moderately developed, moderately abundant with an uneven regaularity. The fractures are generally closely spaced, steeply dipping, and open and often filled with quartz and calcite. The rock is generally moderately resistant to weathering and moderately weathered to a moderate depth. Weathered fragments range in size from elongated and pencil-like to medium sized, irregularly shaped blocks. Smaller fragments result from rapid hydration of minerals in exposed outcrops or rock cuts.

Excavation is moderately easy in weathered zones but may be difficult in unweathered zone of less weathered rock. Foundation stability to good but foundations should be excavated to sound material.

Figure 1 - "Pennsylvania Geologic Data Exploration (PaGEODE)" Web Mapping – Bedrock Geology



4.2 Topsoil

Topsoil was encountered at all the boring locations. The topsoil generally consisted of dark brown organic silt and ranged from approximately 7 to 9 inches in thickness.

4.3 Apparent Fill

Apparent fill material was encountered in Borings B-3, B-4, and B-5 tto depths ranging from 4.0 to 8.0 feet in depth below the existing ground surface. The apparent fill material consisted of similar composition to that of the natural soils but was encountered above a strata containing trace organics indicating that its origin was not native and may have been placed during past reworking of the site. No man-made debris such as brick, concrete, cinders, etc. was observed. The apparent fill material was typically described as light brown, brown, and black in color and generally classified as non-plastic, well-graded GRAVEL with sand based on gradation. "N" values from the Standard Penetration Test (SPT) borings typically indicated relative densities of medium dense.

Since the size of the samples obtained is relatively small in comparison to the areal extent of the site and since the fill materials could be of similar composition to the natural soils encountered at the site, it is often difficult to determine the presence and composition of fill materials from the SPT samples. It should be anticipated that man-placed fill materials may be encountered at other locations and to different depths across the site due to the previous construction that has occurred on and around the project site.

4.4 Natural Soils

Residual soils, derived from the weathering of the parent bedrock, were encountered in the borings below the apparent fill material noted in Borings B-3, B-4, and B-4 and below the topsoil in all other borings. The residual soils continued to the depth at which auger refusal was obtained or bedrock was cored. In general, the residual soils decomposed to a reddish-brown to dark maroon silty SAND mimicking the grain-size and color of the parent bedrock material encountered and coring in Boring B-3. Based on SPT N-values, the residual soils were generally medium dense near the top of the stratum and became more dense and more competent with depth, gradually transitioning to sandstone bedrock. As common with residual soils, more rock fabric was visible with depth and spoon refusals were obtained as the degree of weathering of the parent bedrock decreased with depth.

4.5 Bedrock

Fine-grained sandstone bedrock was encountered cored in Boring B-3 at a depth of 15.0 feet below the existing ground surface. Coring operations continued within this boring until a depth of 25.0 feet at which depth the boring was terminated. All other borings encountered completely weathered sandstone at various depths above the depth at which auger refusal was obtained but due to the weathered nature of the material augers could be advanced and spoon samples could be obtained. Auger refusal, indicating the apparent top of bedrock, was obtained in these borings at depths ranging from 13.0 feet to 21.5 feet below existing site grades.

The sandstone bedrock encountered and cored was generally described as dark maroon, soft to medium hard, completely to highly weathered, thinly bedded, and very broken to very closely fractured. Fracturing and bedding planes were observed to be at shallow dipping. The rock core conditions obtained are summarized as follows:

Test Boring No.	Depth to Bedrock (feet)	Rock Quality Designation (RQD)	Recovery (%)
B-3	15.0	Rock Core 15.0 to 20.0 feet (RQD = 0%) Rock Core 20.0 to 25.0 feet (RQD = 0%)	50% 40%

The rock core samples obtained were observed to have no RQD and low core recoveries indicative of the highly weathered nature of the rock cored. Consequently, rock quality encountered at the site for the depths cored is characterized as very poor as shown on the table below.

Rock Quality Designation (RQD)	Description
0 – 25%	Very Poor
26 – 50%	Poor
51 – 75%	Fair
76 – 90%	Good
91 – 100%	Excellent

4.6 Groundwater

With the exception of Boring B-5, groundwater level readings performed after completion indicate that the boreholes were “dry”. A groundwater depth of 17.5 feet was recorded with Boring B-5 immediately after completion of the borehole. Based on the groundwater depth measured in Boring B-5 and the absence of groundwater in the other borings, it is believed that the groundwater table is relatively deep in the area of the project and therefore should be below any construction related activities.

A more accurate determination of the hydrostatic water table would require the installation of perforated pipes or piezometers which could be monitored over an extended period of time. The actual level of the hydrostatic water table and the amount and level of perched water should be anticipated to fluctuate throughout the year, depending on variations in precipitation, surface run-off, infiltration, site topography, and drainage. The Contractor should determine the actual groundwater levels at the time of construction to evaluate groundwater impact on the proposed construction procedures.

5.0 CONCLUSIONS

The following conclusions have been developed on the basis of the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, HCEA should be consulted so that the recommendations of this report can be reviewed and revised accordingly.

5.1 Expansion of SWM Basin 1A

As requested, an exploration program was performed in the area of the proposed expansion of existing SWM Basin 1A. Available plans indicate a bottom of pond elevation of El. 330 feet for the expansion of SWM Basin 1A. Based on existing ground elevations at the boring locations, cut ranging from 20 to 25 feet will be required to establish the bottom of the facility. Based on the results of the borings, it is anticipated that completely weathered, dark maroon residual soil derived from the weathering process of the

underlying sandstone bedrock will be encountered a depths in the order of 10 to 15 feet below existing grades. Due to the advanced weathered state of the underlying sandstone bedrock, spoon sampling and advancement with hollow stem augers could be performed to the bottom of the pond depths in Borings B-1 and B-2. Less weathered sandstone was encountered at a depth of 15.0 feet in Boring B-3 and auger refusal was obtained. Therefore, coring operations were performed to the proposed bottom of the pond depth. Based on conditions of the core recovered, the sandstone bedrock is completely to highly weathered, soft, and very broken and very closely fractured. Due to the highly weathered condition of the sandstone bedrock encountered, it is anticipated that excavation can be performed using mechanical means.

5.2 Light Pole Foundations

Exploration borings were performed at four (4) proposed light pole locations surrounding the proposed soccer facility. Based on existing ground elevations at the boring locations, it is anticipated that minimal cuts and fills (on the order of 3 feet or less) will be required to establish the proposed finished grade elevations at the proposed light pole bases adjacent to the soccer facility. It is understood that design of the light pole foundations will be performed by others. It is anticipated that drilled shafts will be used to support the loading associated with the light poles and lighting units.

It should be noted that auger refusal, indicating the apparent top of bedrock, was encountered in Boring B-6 (Light Pole S3) at a depth of 13.0 feet below the existing ground surface. In the event the required length of the drilled shaft extends below this depth, it is anticipated that the excavation will require use of a rock auger and advancement rate will be somewhat slower to excavate this section of the shaft.

6.0 REMARKS

This study has been prepared to aid in the evaluation of the site for the proposed construction. It is considered that adequate recommendations have been provided to serve as a basis for design and preparation of plans and specifications. Additional recommendations can be provided as needed.

These analyses and recommendations are, of necessity, based on the information made available to us at the time of the actual writing of the report and the on-site surface and subsurface conditions, that existed at the time the exploratory borings were drilled. Further assumptions have been made that the limited exploratory borings, in relation both to the areal extent of the site and to depth, are representative of conditions across the site.

If subsurface conditions are encountered which differ from those reported herein, this Office should be notified immediately so that the analyses and recommendations can be reviewed and/or revised as necessary. It is also recommended that:

1. We be given the opportunity to review any plans and specifications in order to comment on the interaction of the soil conditions as described herein and the design requirements.

2. The Geotechnical Engineer or an experienced Soils Technician be present at the site during the construction phase to document installation according to the approved plans and specifications. This is particularly important during excavation, placement, and compaction of fill materials.

Please note that successful completion of the project is dependent on your compliance with all of the recommendations provided in this report. While represented separately, the recommendations represent work that is intertwined.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties either implied or expressed. Hillis-Carnes Engineering Associates, Inc. assumes no responsibility for interpretations made by others based on work or recommendations made by HCEA.

APPENDIX

Figure 1 - Project Location Map

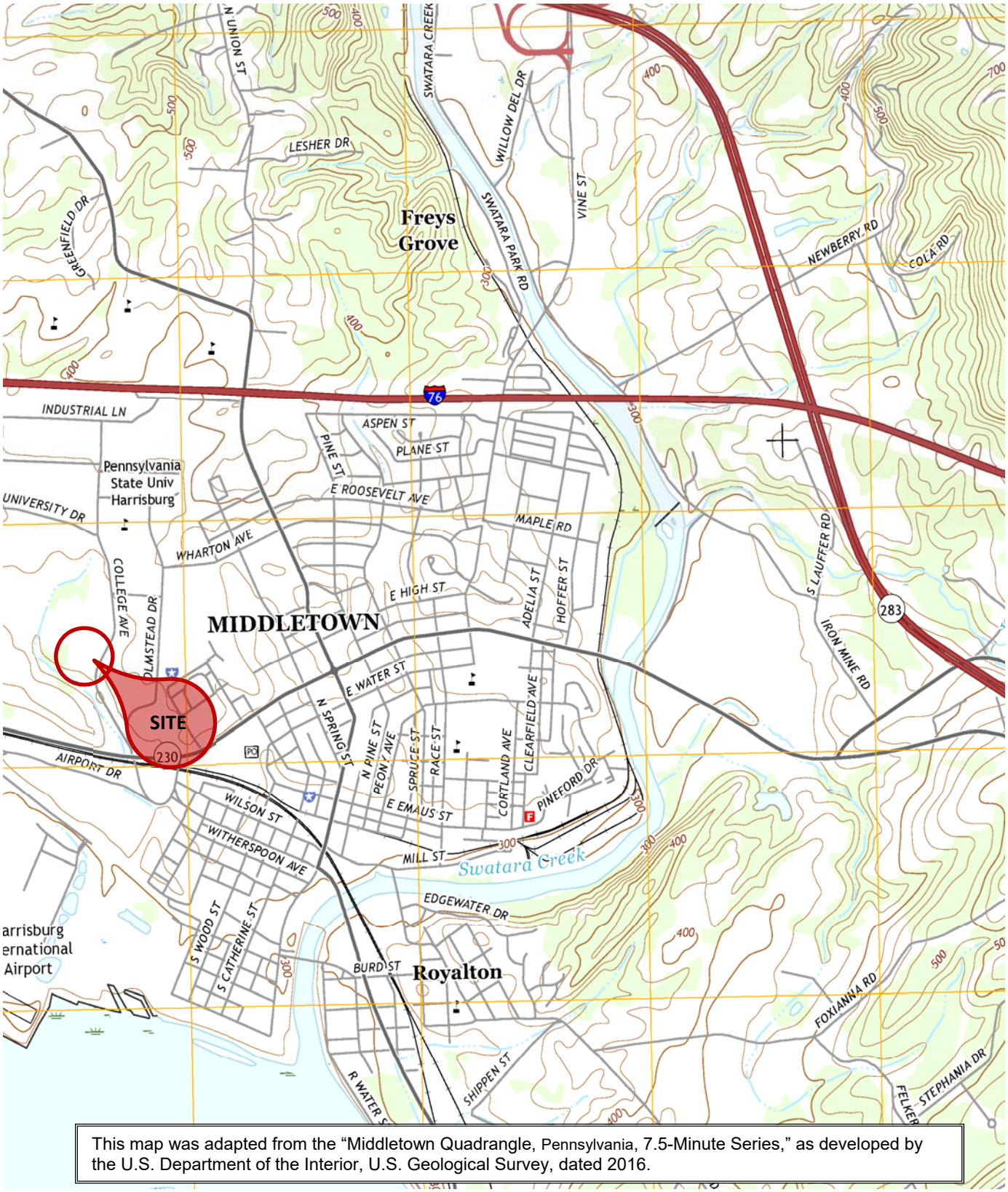
Figure 2 – Aerial Location Map

Figure 3 – Boring Location Plan

Record of Soil Exploration

Laboratory Testing Results

Field Classification Sheet



This map was adapted from the "Middletown Quadrangle, Pennsylvania, 7.5-Minute Series," as developed by the U.S. Department of the Interior, U.S. Geological Survey, dated 2016.

HILLIS-CARNES ENGINEERING ASSOCIATES

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PROJECT LOCATION MAP

FIGURE 1

Penn State University - Harrisburg Campus
Proposed Soccer Competition and Practice Field Improvement Project
Middletown, PA

JOB NO:	R19044	**DRAWN BY:**	NJL
DATE:	6/20/19	**CHECKED BY:**	JJH
SCALE:	NTS		
PAGE:	1		

This sketch was adapted from Google Earth Aerial Imagery, 2016 – "777 West Harrisburg Pike, Middletown, PA.

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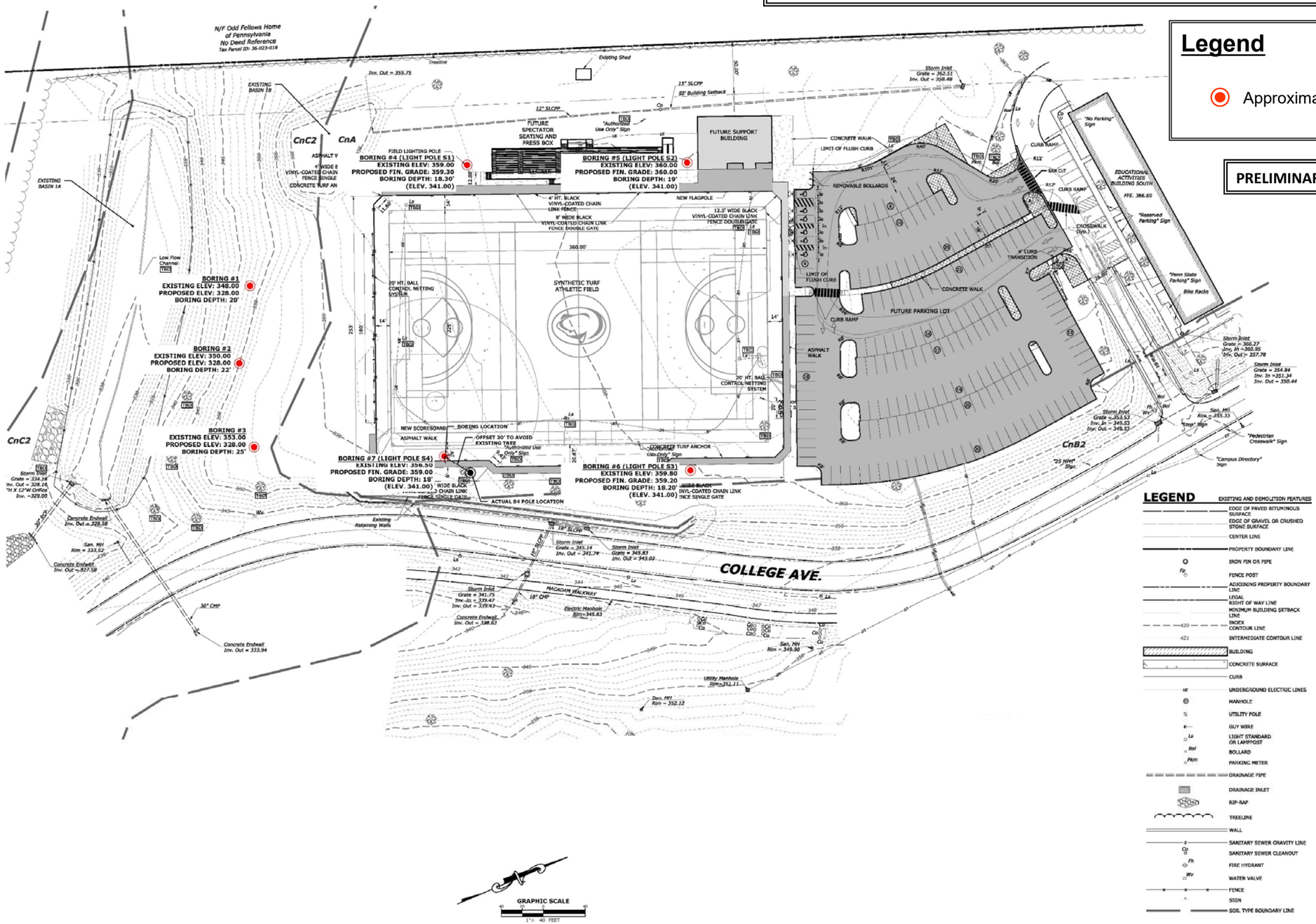
AERIAL LOCATION MAP

FIGURE 2

Penn State University - Harrisburg Campus
Proposed Soccer Competition and Practice Field Improvement Project
Middletown, PA

JOB NO:	R19044	**DRAWN BY:**	NJL
DATE:	6/20/19	**CHECKED BY:**	JJH
SCALE:	NTS		
PAGE:	1		

This sketch was adapted from drawing titled “Boring Location Plan” prepared by K&W Engineers and dated May 31, 2019.



Legend

- Approximate Test Boring Location

PRELIMINARY – NOT FOR CONSTRUCTION PURPOSES

LEGEND EXISTING AND DEMOLITION FEATURES

- EDGE OF PAVED BITUMINOUS SUSFACE
- EDGE OF GRAVEL OR CRUSHED STONE SURFACE
- CENTER LINE
- PROPERTY BOUNDARY LINE
- IRON PIN OR PIPE
- FENCE POST
- ADJOINING PROPERTY BOUNDARY LINE
- LEGAL RIGHT OF WAY LINE
- MINIMUM BUILDING SETBACK LINE
- INDEX CONTOUR LINE
- INTERMEDIATE CONTOUR LINE
- BUILDING
- CONCRETE SURFACE
- CURB
- UNDERGROUND ELECTRIC LINES
- MANHOLE
- UTILITY POLE
- GUY WIRE
- LIGHT STANDARD OR LAMPPOST
- BOLLARD
- PARKING METER
- DRAINAGE PIPE
- DRAINAGE INLET
- RIP-RAP
- TREELINE
- WALL
- SANITARY SEWER GRAVITY LINE
- SANITARY SEWER CLEANOUT
- FIRE HYDRANT
- WATER VALVE
- FENCE
- SIGN
- SOIL TYPE BOUNDARY LINE

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BORING LOCATION PLAN

FIGURE 3

Penn State University – Harrisburg Campus
Proposed Soccer and Competition and Practice Field Improvement Project
Middletown, PA

JOB NO:	R19044	**DRAWN BY:**	NJL
DATE:	6/20/2019	**CHECKED BY:**	JJH
SCALE:	AS SHOWN		
PAGE:	1		

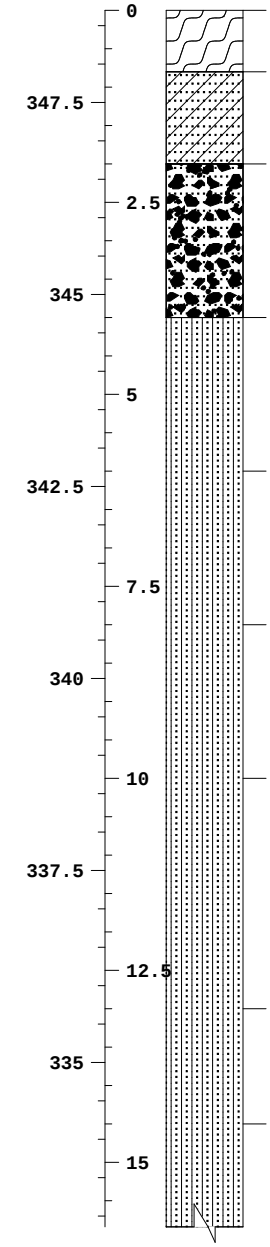
HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** | Boring No.: B-1
Location: Northern Expansion of Existing SWM Basin 1A | Job #: R19044

SAMPLER

Datum		Hammer Wt.	140 lbs.	Hole Diameter	3.25" ID	Foreman	G. Kerr / Negley's Drilling
Surf. Elev.	348.70 Ft.	Hammer Drop	30 in.	Rock Core Diameter	N/A	Classified By	M. Birch / HCEA
Date Started	6/4/2019	Pipe Size	N/A in.	Boring Method	HSA	Date Completed	6/4/2019



Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve
0	0.0' - 0.8': TOPSOIL	Soil classifications based on Visual-Manual procedure (ASTM D2488) unless laboratory classified.	1.1'		3-3-4-3	7	
347.5	0.8' - 2.0': Sandy CLAY with gravel (cl), brown, moist						
2.5	2.0' - 4.0': Well-graded GRAVEL with sand (gw), brown, light brown, and gray, moist - gravel is angular sandstone fragments		1.9'		6-7-6-10	13	
345	4.0' - 20.0': Silty SAND (sm), dark maroon, moist (Completely weathered SANDSTONE)		1.8'		4-10-10-12	20	
5							
342.5			2.0'		10-11-12-11	23	
7.5							
340			1.8'	13.6	4-6-10-11	16	
10							
337.5							
12.5			1.0'	13.1	19-19-50/.5	69	
335							
15							

SPT Blows/Foot Curve: 10 30 50

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	Dry ft.	N/A ft.
AFTER 24 HRS.	ft.	ft.
AFTER ___ HRS.	ft.	ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-1

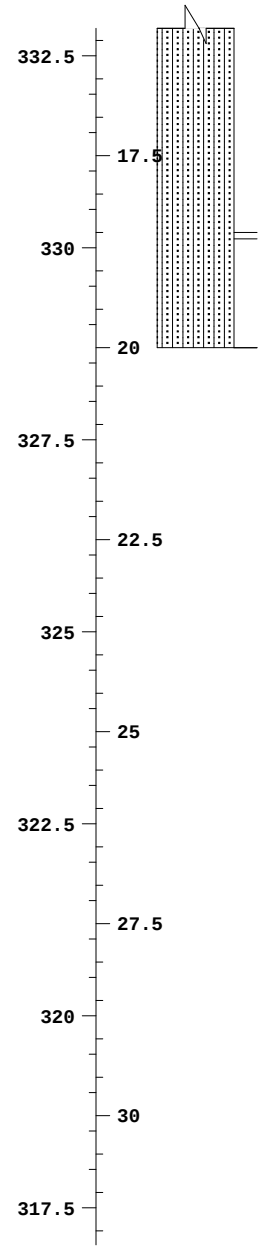
Location: Northern Expansion of Existing SWM Basin 1A Job #: R19044

SAMPLER

Datum: ____ Hammer Wt.: 140 lbs. Hole Diameter: 3.25" ID Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 348.70 Ft. Hammer Drop: 30 in. Rock Core Diameter: N/A Classified By: M. Birch / HCEA

Date Started: 6/4/2019 Pipe Size: N/A in. Boring Method: HSA Date Completed: 6/4/2019



Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve (10 30 50)
				0.0'		50/.1	100	100
		Bottom of Boring at 20.0 feet	Auger refusal at 20.0'	0.0'		50/.0	100	100

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	Dry	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-2

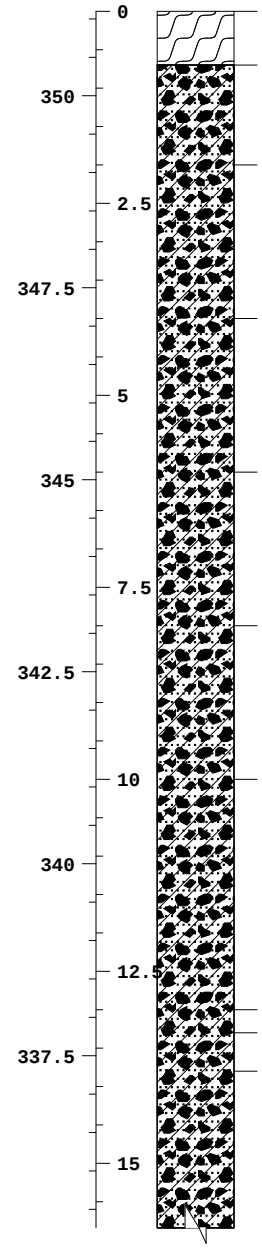
Location: Northern Expansion of Existing SWM Basin 1A Job #: R19044

SAMPLER

Datum: ____ Hammer Wt.: 140 lbs. Hole Diameter: 3.25" ID Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 351.1 Ft. Hammer Drop: 30 in. Rock Core Diameter: N/A Classified By: M. Birch / HCEA

Date Started: 6/4/2019 Pipe Size: N/A in. Boring Method: HSA Date Completed: 6/4/2019



Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve
0	0.0' - 0.7': TOPSOIL	Soil classifications based on Visual-Manual procedure (ASTM D2488) unless laboratory classified.	1.5'		3-4-4-4	8	
350	0.7' - 18.0': Clayey SAND with gravel (sc), light brown, brown, and reddish-brown, moist						
2.5			0.9'		2-1-2-1	3	
347.5	- gravel is angular sandstone fragments						
5			0.7'		3-2-2-2	4	
345			0.0'		2-2-2-3	4	
7.5			1.5'	18.7	3-3-2-6	5	
342.5							
10							
340							
12.5			0.6'	17.8	13-50/.3	100	100
337.5							
15							

SPT Blows/Foot Curve: 10 30 50

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	Dry	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-2

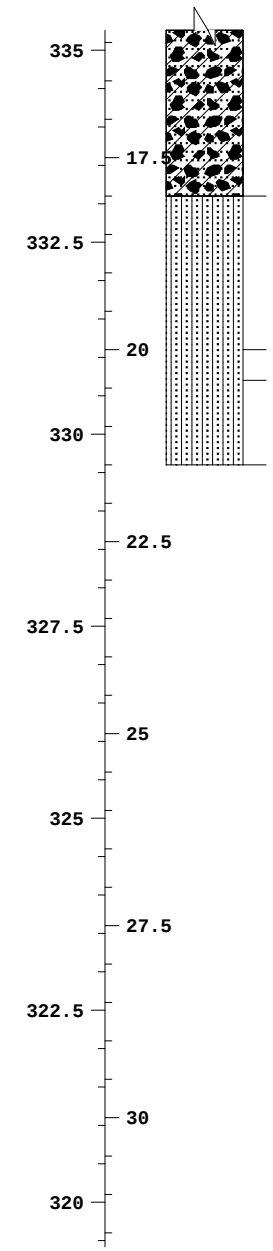
Location: Northern Expansion of Existing SWM Basin 1A Job #: R19044

SAMPLER

Datum: ____ Hammer Wt.: 140 lbs. Hole Diameter: 3.25" ID Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 351.1 Ft. Hammer Drop: 30 in. Rock Core Diameter: N/A Classified By: M. Birch / HCEA

Date Started: 6/4/2019 Pipe Size: N/A in. Boring Method: HSA Date Completed: 6/4/2019



Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve
17.5	18.0' - 21.5': Silty SAND (sm), dark maroon, moist (Completely weathered SANDSTONE)		1.8'	10.5	8-18-22-38	40	
20			0.1'		50/.4	100	100
22.5	Bottom of Boring at 21.5 feet	Auger refusal at 21.5'					

10 30 50

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	Dry	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** | Boring No.: B-3
Location: Northern Expansion of Existing SWM Basin 1A | Job #: R19044

SAMPLER

Datum		Hammer Wt.	140 lbs.	Hole Diameter	3.25" ID	Foreman	G. Kerr / Negley's Drilling
Surf. Elev.	353.7 Ft.	Hammer Drop	30 in.	Rock Core Diameter	NQ2 - 2.0"	Classified By	M. Birch / HCEA
Date Started	6/4/2019	Pipe Size	N/A in.	Boring Method	HSA	Date Completed	6/4/2019

Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve (10 30 50)
0 / 352.5	0.0' - 0.6': TOPSOIL	Soil classifications based on Visual-Manual procedure (ASTM D2488) unless laboratory classified.	2.0'		3-5-6-6	11	
2.5 / 350	0.6' - 4.0': Well-graded GRAVEL with sand (gw), light brown, brown, and black, moist (Apparent FILL) - gravel is angular sandstone fragments		1.5'		7-8-11-12	19	
5 / 347.5	4.0' - 6.0': Silty CLAY with sand (cl-ml), brown and light brown, moist, with trace organics - gravel is sandstone fragments		1.4'	10.7	6-11-13-13	24	
7.5 / 345	6.0' - 15.0': Silty SAND (sm), dark maroon, moist (Completely weathered SANDSTONE)		1.3'		12-15-12-14	27	
			2.0'		7-8-17-40	25	
10 / 342.5							
12.5 / 340			1.1	10.3	19-36-50/.3	100	100
15	15.0' - 25.0': SANDSTONE, dark maroon, soft to medium hard,	Auger refusal at 15.0'	2.5'				

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	Dry ft.	N/A ft.
AFTER 24 HRS.	ft.	ft.
AFTER ___ HRS.	ft.	ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-3

Location: Northern Expansion of Existing SWM Basin 1A Job #: R19044

SAMPLER

Datum: ____ Hammer Wt.: 140 lbs. Hole Diameter: 3.25" ID Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 353.7 Ft. Hammer Drop: 30 in. Rock Core Diameter: NQ2 - 2.0" Classified By: M. Birch / HCEA

Date Started: 6/4/2019 Pipe Size: N/A in. Boring Method: HSA Date Completed: 6/4/2019

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve (10 30 50)
337.5		completely to highly weathered, thinly bedded, very broken to very closely fractured, shallow dip fractures	R-1: 15.0'-20.0' Rec=50%, RQD=0%					
17.5								
335								
20			R-2: 20.0'-25.0' Rec=40%. RQD=0%	2.0'				
332.5								
22.5								
330								
25		Bottom of Boring at 25.0 feet						
327.5								
27.5								
325								
30								
322.5								

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	Dry	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-4

Location: Proposed Light Pole S1 Job #: R19044

SAMPLER

Datum: | Hammer Wt.: 140 lbs. | Hole Diameter: 3.25" ID | Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 358.9 Ft. | Hammer Drop: 30 in. | Rock Core Diameter: N/A | Classified By: M. Birch / HCEA

Date Started: 6/4/2019 | Pipe Size: N/A in. | Boring Method: HSA | Date Completed: 6/4/2019

Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve
0 / 358.9	0.0' - 0.8': TOPSOIL	Soil classifications based on Visual-Manual procedure (ASTM D2488) unless laboratory classified.	1.3'		WOH-WOH-WOH-1	1	
357.5 / 2.5	0.8' - 2.0': Silty CLAY (cl-ml), brown, moist (Apparent FILL)						
	2.0' - 8.0': Silty SAND (sm), tan and grayish-tan, moist (Apparent FILL)		1.5'		3-5-8-10	13	
355 / 5			1.9'		6-6-8-11	14	
352.5 / 7.5			1.7'	20.0	13-15-11-11	26	
	8.0' - 14.0': Silty CLAY with sand (cl-ml), reddish-brown and brown, moist S-5: with organics/roots		0.9'		6-13-11-10	24	
350 / 10							
347.5 / 12.5			1.5'	15.3	2-8-12-20	20	
345 / 15	14.0' - 19.5': Silty SAND (sm), maroon, moist (Completely weathered SANDSTONE)						

Curve: 10 30 50

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	Dry ft.	N/A ft.
AFTER 24 HRS.	ft.	ft.
AFTER ___ HRS.	ft.	ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-4

Location: Proposed Light Pole S1 Job #: R19044

SAMPLER

Datum: | Hammer Wt.: 140 lbs. | Hole Diameter: 3.25" ID | Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 358.9 Ft. | Hammer Drop: 30 in. | Rock Core Diameter: N/A | Classified By: M. Birch / HCEA

Date Started: 6/4/2019 | Pipe Size: N/A in. | Boring Method: HSA | Date Completed: 6/4/2019

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve (10 30 50)
342.5 / 17.5								
340 / 20		Bottom of Boring at 19.5 feet		1.0'		11-21-50/.5	71	71
337.5 / 22.5								
335 / 25								
332.5 / 27.5								
330 / 30								
327.5								

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	Dry	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-5

Location: Proposed Light Pole S2 Job #: R19044

SAMPLER

Datum: | Hammer Wt.: 140 lbs. | Hole Diameter: 3.25" ID | Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 360.0 Ft. | Hammer Drop: 30 in. | Rock Core Diameter: N/A | Classified By: M. Birch / HCEA

Date Started: 6/4/2019 | Pipe Size: N/A in. | Boring Method: HSA | Date Completed: 6/4/2019

Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve
360 / 0	0.0' - 0.7': TOPSOIL	Soil classifications based on Visual-Manual procedure (ASTM D2488) unless laboratory classified.	1.4'		WOH-3-4-4	7	
	0.7' - 5.0': Silty CLAY (cl-ml), brown, moist (Apparent FILL)						
357.5 / 2.5	- with trace organics at 4.5'-5.0'		1.5'		4-5-5-8	10	
			2.0'		3-8-13-11	21	
355 / 5	5.0' - 15.0': Silty GRAVEL with sand (GM), brown, reddish-brown, and black, moist			10.1			
			1.5'		12-9-10-15	19	
352.5 / 7.5							
			1.3'		7-12-13-12	25	
350 / 10							
347.5 / 12.5		S-6 Lab Tested: USCS Class=GM, Non-plastic	1.0'		10-10-9-14	19	
345 / 15	15.0' - 20.0': Silty SAND (sm), brown and reddish-brown, moist						

SPT Blows/Foot Curve: 10 30 50

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	17.5 ft.	N/A ft.
AFTER 24 HRS.	ft.	ft.
AFTER ___ HRS.	ft.	ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-5

Location: Proposed Light Pole S2 Job #: R19044

SAMPLER

Datum: _____ Hammer Wt.: 140 lbs. Hole Diameter: 3.25" ID Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 360.0 Ft. Hammer Drop: 30 in. Rock Core Diameter: N/A Classified By: M. Birch / HCEA

Date Started: 6/4/2019 Pipe Size: N/A in. Boring Method: HSA Date Completed: 6/4/2019

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve (10 30 50)
342.5 — 17.5		(Completely weathered SANDSTONE)		1.3'	15.3	12-20-18-19	38	
340 — 20		Bottom of Boring at 20.0 feet						
337.5 — 22.5								
335 — 25								
332.5 — 27.5								
330 — 30								

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	17.5	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-6

Location: Proposed Light Pole S3 Job #: R19044

SAMPLER

Datum: _____ Hammer Wt.: 140 lbs. Hole Diameter: 3.25" ID Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 359.7 Ft. Hammer Drop: 30 in. Rock Core Diameter: N/A Classified By: M. Birch / HCEA

Date Started: 6/4/2019 Pipe Size: N/A in. Boring Method: HSA Date Completed: 6/4/2019

Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve
0	0.0' - 0.7': TOPSOIL	Soil classifications based on Visual-Manual procedure (ASTM D2488) unless laboratory classified.	1.9'		2-3-5-8	8	
357.5 (2.5)	0.7' - 4.0': Silty CLAY (cl-ml), brown, moist		2.0'		4-3-4-5	7	
355 (5)	4.0' - 10.5': Well-graded GRAVEL with sand (gw), brown, tan, and reddish-brown, moist		1.0'		4-10-13-11	23	
			1.1'	10.4	12-11-5-7	16	
352.5 (7.5)			1.5'	8.5	5-9-10-12	19	
350 (10)	10.5' - 13.0': Silty SAND (sm), dark maroon, moist (Highly weathered SANDSTONE)						
347.5 (12.5)	Bottom of Boring at 13.0 feet	Auger refusal at 13.0'	0.0'		50/.0	100	100
345 (15)							

SPT Blows/Foot Curve: 10 30 50

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	Dry	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-7

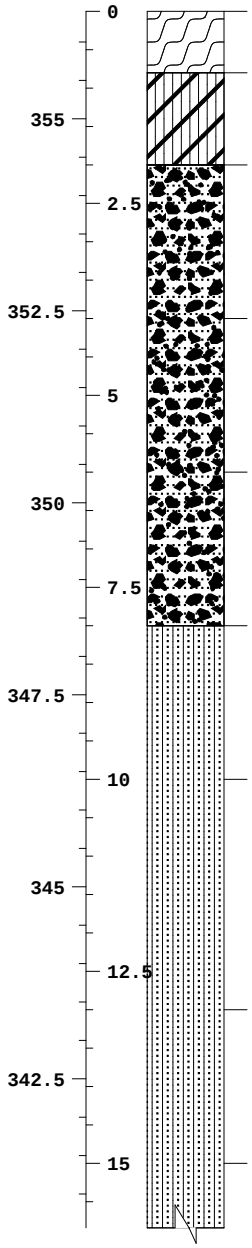
Location: Proposed Light Pole S4 Job #: R19044

SAMPLER

Datum: _____ Hammer Wt.: 140 lbs. Hole Diameter: 3.25" ID Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 356.4 Ft. Hammer Drop: 30 in. Rock Core Diameter: N/A Classified By: M. Birch / HCEA

Date Started: 6/4/2019 Pipe Size: N/A in. Boring Method: HSA Date Completed: 6/4/2019



Elevation/ Depth	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve
0	0.0' - 0.8': TOPSOIL	Soil classifications based on Visual-Manual procedure (ASTM D2488) unless laboratory classified.	2.0'		2-2-1-2	3	
355	0.8' - 2.0': Clayey SILT (ml- cl), brown, moist						
2.5	2.0' - 8.0': Well-graded GRAVEL with sand (gw), light brown, browm, and black, moist - gravel is angular sandstone fragments		1.5'		7-17-20-24	37	
352.5			1.4'		6-17-21-20	38	
5							
350			0.9'		14-18-20-18	38	
7.5							
347.5	8.0' - 18.0': Silty SAND (SM), reddish-browm to maroon, moist (Completely weathered SANDSTONE)	S-7 Lab Tested: USCS Class=SM, Non-plastic	1.5'	15.3	7-8-11-12	19	
10							
345							
12.5							
342.5			2.0'	13.3	9-12-26-25	38	
15							

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER		CAVE IN DEPTH	
AT COMPLETION	Dry	ft.	N/A	ft.
AFTER 24 HRS.		ft.		ft.
AFTER ___ HRS.		ft.		ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **PSU Harrisburg - Proposed Soccer Competition and Practice Field** Boring No.: B-7

Location: Proposed Light Pole S4 Job #: R19044

SAMPLER

Datum: | Hammer Wt.: 140 lbs. | Hole Diameter: 3.25" ID | Foreman: G. Kerr / Negley's Drilling

Surf. Elev.: 356.4 Ft. | Hammer Drop: 30 in. | Rock Core Diameter: N/A | Classified By: M. Birch / HCEA

Date Started: 6/4/2019 | Pipe Size: N/A in. | Boring Method: HSA | Date Completed: 6/4/2019

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	SPT Blows/Foot N	SPT Blows/Foot Curve (10 30 50)
340 / 17.5		Bottom of Boring at 18.0 feet	Auger refusal at 18.0'	0.0		50/.0	100	100
337.5 / 20								
335 / 22.5								
332.5 / 25								
330 / 27.5								
327.5 / 30								
325								

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

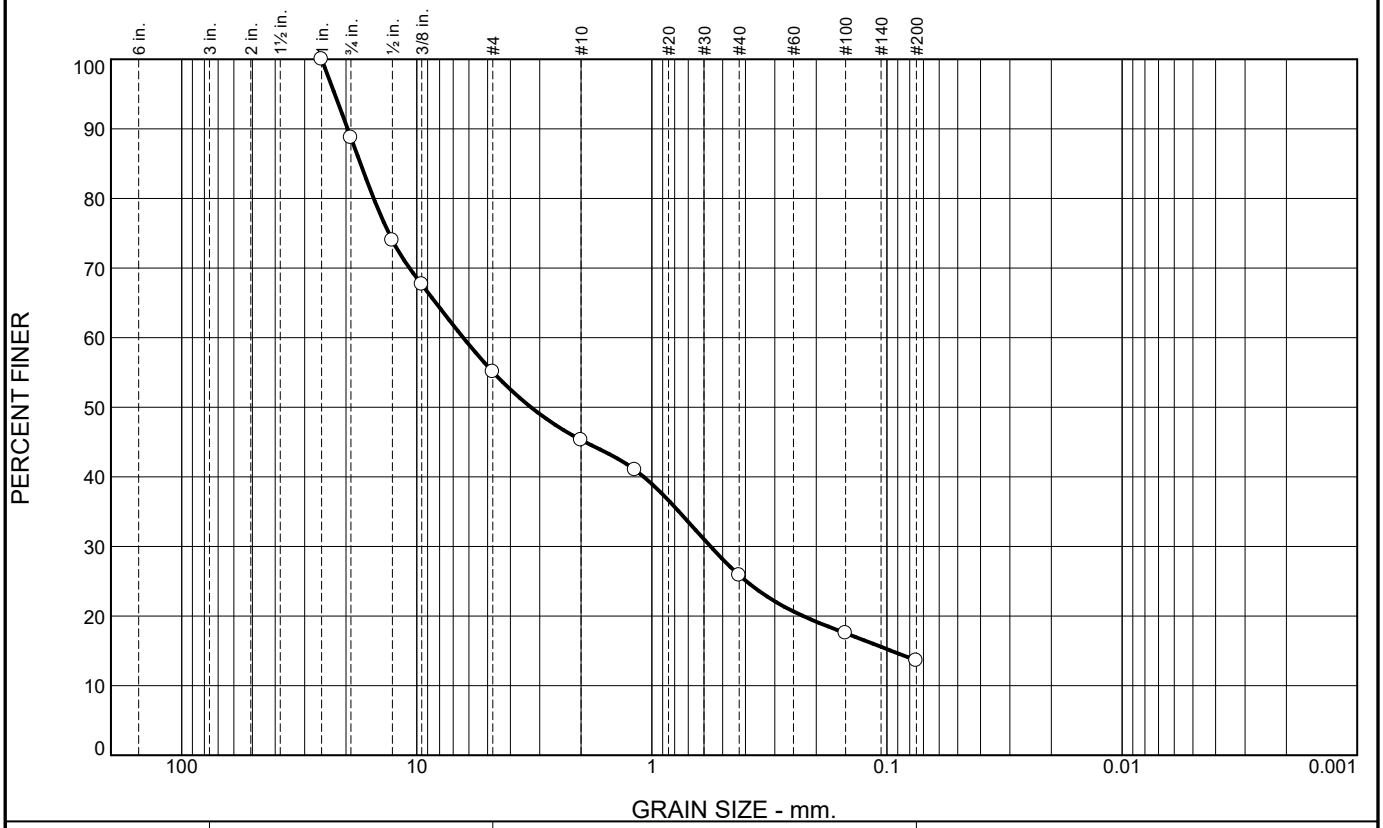
SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	Dry ft.	N/A ft.
AFTER 24 HRS.	ft.	ft.
AFTER ___ HRS.	ft.	ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.3	33.6	9.8	19.4	12.3	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	88.7		
.5	74.0		
.375	67.7		
#4	55.1		
#10	45.3		
#16	41.0		
#40	25.9		
#100	17.5		
#200	13.6		

* (no specification provided)

Material Description

Brown Silty Gravel with Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 19.6673 D_{85}= 17.3479 D_{60}= 6.3437
D_{50}= 3.2664 D_{30}= 0.5627 D_{15}= 0.0956
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

Boring No. 5 Sample No. 6
Depth: 13.0' - 15.0'
NMC = 10.1%

Location: Middletown, PA
Sample Number: 1

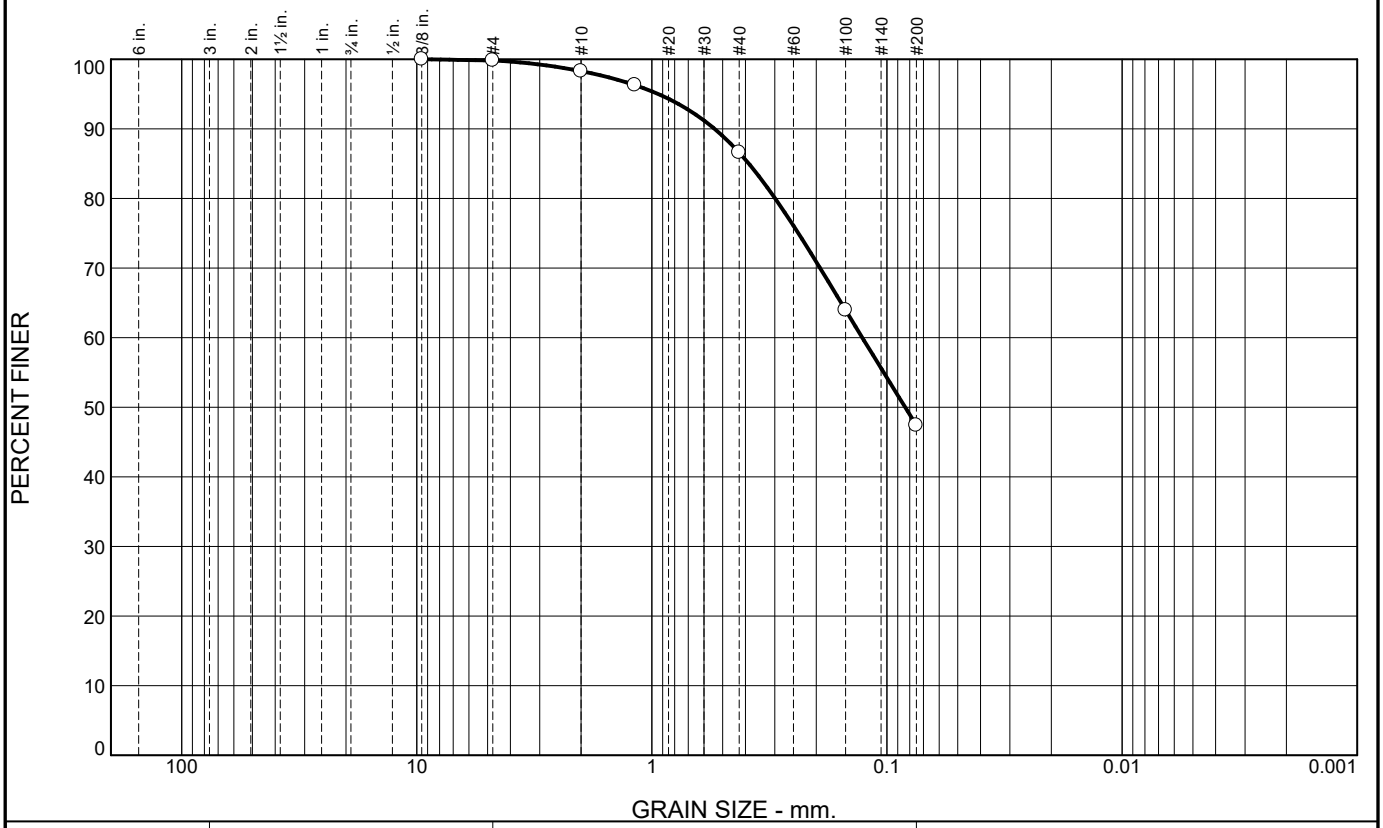
Date: 6-11-19

HILLIS-CARNES ENGINEERING ASSOCIATES

Harrisburg, Pennsylvania

Client: Penn State University
Project: Soccer Field Improvements
Penn State University Harrisburg Campus
Project No: R19044 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	1.5	11.7	39.2	47.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.8		
#10	98.3		
#16	96.3		
#40	86.6		
#100	64.0		
#200	47.4		

* (no specification provided)

Material Description

Reddish-Brown Silty Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 0.5412 D_{85}= 0.3870 D_{60}= 0.1273
D_{50}= 0.0837 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Boring No. 7 Sample No. 5
Depth: 8.0' - 10.0'
NMC = 15.3%

Location: Middletown, PA
Sample Number: 2

Date: 6-11-19

HILLIS-CARNES ENGINEERING ASSOCIATES

Harrisburg, Pennsylvania

Client: Penn State University
Project: Soccer Field Improvements
Penn State University Harrisburg Campus
Project No: R19044 **Figure**

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

3110 Pike Street • Harrisburg, PA 17111

PHONE: (717) 561-1623 • FAX: (717) 754-0084

Description of Soils – per ASTM D2487

Major Component	Component Type	Component Description	Symbol	Group Name
Coarse-Grained Soils, More than 50% is retained on the No. 200 sieve	**Gravels** – More than 50% of the coarse fraction is retained on the No. 4 sieve. Coarse = 1" to 3" Medium = ½" to 1" Fine = ¼" to ½"	Clean Gravels <5% Passing No. 200 sieve	**GW**	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravels with fines, >12% Passing the No. 200 sieve	**GM**	Silty Gravel
			GC	Clayey Gravel
	Sands – More than 50% of the coarse fraction passes the No. 4 sieve. Coarse = No.10 to No.4 Medium = No. 10 to No. 40 Fine = No. 40 to No. 200	Clean Sands <5% Passing No. 200 sieve	**SW**	Well Graded Sand
			SP	Poorly Graded Sand
		Sands with fines, >12% Passing the No. 200 sieve	**SM**	Silty Sand
			SC	Clayey Sand
Fine Grained Soils, More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit is less than 50 Low to medium plasticity	Inorganic	**ML**	Silt
			CL	Lean Clay
		Organic	**OL**	Organic silt
				Organic Clay
	Silts and Clays Liquid Limit of 50 or greater Medium to high plasticity	Inorganic	**MH**	Elastic Silt
			CH	Fat Clay
		Organic	**OH**	Organic Silt
				Organic Clay
Highly Organic Soils	Primarily Organic matter, dark color, organic odor		**PT**	Peat

Proportions of Soil Components

Component Form	Description	Approximate percent by weight
Noun	Sand, Gravel, Silt, Clay, etc.	50% or more
Adjective	Sandy, silty, clayey, etc.	35% to 49%
Some	Some sand, some silt, etc.	12% to 34%
Trace	Trace sand, trace mica, etc.	1% to 11%
With	With sand, with mica, etc.	Presence only

Particle Size Identification

Particle Size	Particle dimension
Boulder	12" diameter or more
Cobble	3" to 12" diameter
Gravel	¼" to 3" diameter
Sand	0.005" to ¼" diameter
Silt/Clay (fines)	Cannot see particle

Cohesive Soils

Field Description	No. of SPT Blows/ft	Consistency
Easily Molded in Hands	0 – 3	Very Soft
Easily penetrated several inches by thumb	4 – 5	Soft
Penetrated by thumb with moderate effort	6 – 10	Medium Stiff
Penetrated by thumb with great effort	11 – 30	Stiff
Indented by thumb only with great effort	Greater than 30	Hard

Granular Soils

No. of SPT Blows/ft	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
Greater than 50	Very Dense

Other Definitions**:**

- **Fill:** Encountered soils that were placed by man. Fill soils may be controlled (engineered structural fill) or uncontrolled fills that may contain rubble and/or debris.
- **Saprolite**: Soil material derived from the in-place chemical and physical weathering of the parent rock material. May contain relic structure. Also called residual soils. Occurs in Piedmont soils, found west of the fall line.
- **Disintegrated Roc**k: Residual soil material with rock-like properties, very dense, N = 60 to 51/0".
- **Karst:** Descriptive term which denotes the potential for solutioning of the limestone rock and the development of sinkholes.
- **Alluvium:** Recently deposited soils placed by water action, typically stream or river floodplain soils.
- **Groundwater Level**: Depth within borehole where water is encountered either during drilling, or after a set period of time to allow groundwater conditions to reach equilibrium.
- **Caved Depth:** Depth at which borehole collapsed after removal of augers/casing. Indicative of loose soils and/or groundwater conditions**.**

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 FIELD 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 trafficways if required by Owner or authorities having jurisdiction.

B. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

C. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 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.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

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 (200 mm) 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 depth **of** 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Do not stockpile topsoil within tree protection zones.
2. Relocate surplus topsoil to a location on Owner’s property within 2 miles distance. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. 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 unless directed otherwise.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for pavements, turf and grasses and plants.
3. Excavating and backfilling for buildings and structures.
4. Subbase course for concrete pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping **and stockpiling** topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
3. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
4. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (300 by 300 mm).
2. Warning Tape: 12 inches (300 mm) long; of each color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures are in place.

C. The following practices are prohibited within tree protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Erection of sheds or structures.
4. Impoundment of water.
5. Excavation or other digging unless otherwise indicated.
6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

D. Do not direct vehicle or equipment exhaust towards protection zones.

E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.

J. Sand: ASTM C33/C33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:
   a. As follows:

      1) Grab Tensile Strength: 157 lbf (700 N); ASTM D4632.
      2) Sewn Seam Strength: 142 lbf (630 N); ASTM D4632.
      3) Tear Strength: 56 lbf (250 N); ASTM D4533.
      4) Puncture Strength: 56 lbf (250 N); ASTM D4833.

   b. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D4751.
   c. Permittivity: 0.5 per second, minimum; ASTM D4491.
   d. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 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:

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.

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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives:

1. 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.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches (600 mm) outside of concrete forms other than at footings.
b. 12 inches (300 mm) outside of concrete forms at footings.
c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
f. 6 inches (150 mm) beneath pipe in trenches and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms:

1. 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.

a. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
b. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
d. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction[, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 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.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.

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

3.12 UTILITY TRENCH BACKFILL

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

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

D. Trenches under Roadways: Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase course.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry density.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry density according to ASTM D698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Pavements: Plus or minus 1/2 inch (13 mm).

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.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry density according to ASTM D698.

3.18 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

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 Architect.

D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) 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 materials to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

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

END OF SECTION 312000

SECTION 31 1300

SELECTIVE TREE REMOVAL AND TRIMMING

PART 1 GENERAL

1.00 RELATED DOCUMENTS

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

1.01 WORK INCLUDED

A. Provide all work necessary to perform selective clearing within the limits indicated on the Drawings and as specified herein. Selective clearing work shall include, but not be limited to, the following:

1. Tree pruning.
2. Removal of vines from trees.
3. Removal of wire from trees.
4. Cabling and guying of trees.
5. Flush cutting shrubs and trees, and grinding of stumps and backfilling of holes with clean fill and topdress with 6 in. loam.
6. Weeping tree crotches and cavities.
7. Removal of deadwood and brush.
8. Removal of all rubbish, debris, and other materials to be disposed of as a result of the work of this section.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 01 56 39, TEMPORARY TREE PROTECTION.
2. Section 02 41 10, SITE PREPARATION; Clearing and grubbing and removal and disposal of felled trees and stumps outside of the work limits of this section: .
3. Section 31 10 00, SITE CLEARING.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American National Standards Institute (ANSI):

A300	Best Management Practices Tree Support Systems: Cabling, Bracing, and Guying
Z133.1	Safety Requirements for Pruning, Trimming, Repairing, Maintaining and Removing Trees, and for Cutting Brush

Z133A	Best Management Practices Tree and Shrub Fertilization

2. Tree Care Industry Association, 3537 Stratford Rd., Wantagh, NY 11793 (TCIA):

Ref. 1	Pruning Standards for Shade Trees
Ref. 2	Standard for Fertilizing Shade and Ornamental Trees
Ref. 3	Bracing, Cabling and Guying Standard for Shade Trees.

1.04 SUBMITTALS

A. The Contractor shall submit to the Architect for review, proposed methods and materials for selective clearing, including a schedule indicating specific dates for implementing specific work items in each major work area.

1.05 QUALITY ASSURANCE

A. Selective clearing and pruning methods shall conform to the applicable requirements of ANSI Z133.1

B. Work of this section shall be completed by a professional ISA Certified Arborist with a minimum five years experience, who has successfully completed an exam and education program equal to the International Society of Arboriculture (ISA) Certification Program, sponsored by the International Society of Arboriculture 2009, P.O. Box 3129, Champaign, IL 61826 (217) 355-9411; Email: isa@isa-arbor.com.

1.06 TREE DAMAGE PENALTIES

A. Refer to Section 01 56 39, TEMPORARY TREE AND PLANT PROTECTION.

PART 2 PRODUCTS

2.01 CABLES AND GUYING MATERIALS:

A. Materials for guying and cabling trees shall conform to TCIA Ref. 3.

PART 3 EXECUTION

3.01 TREE PRUNING

A. Tree pruning shall be "Class II Medium Pruning" conforming to TCIA Ref. 1.unless otherwise noted. Work shall conform to the requirements of ANSI Z133.1.

1. Class II Pruning: Medium Pruning the removal of dead, dying, diseased, interfering, objectionable, obstructing, and weak branches,a s well as selective thinning to lessen wind resistance; an occasional branch as described , up to 1 in. diameter may remain within the main leaf area up to its full length when it is not practical to remove it.

B. Schedule of trees to be pruned and extent of pruning shall be as indicated on the Drawings. Tree pruning shall be as directed and approved by the Architect.

3.02 GOVERNING STANDARDS - PRUNING

A. Work procedures will be guided by the current provisions of the American National Standard Institute. Complete detail of the provisions are to be found in the references listed. The three basic objectives of the pruning operation shall include:

1. Hazard Reduction Pruning: Hazard reduction pruning shall be completed to remove visible hazards in a tree. Hazard pruning shall consist of one or more of the maintenance pruning types.
2. Crown Reduction Pruning: shall be performed in accordance with ANSI A300 Part 1 Pruning standards using the Reduce Method (7.4). A written description that details the location and size of branches to be removed shall be approved by the Architect and Certified Arborist prior to the start of work.
3. Maintenance Pruning: Maintenance pruning shall be completed to maintain and improve tree health and structure and includes hazard and crown reduction pruning.

3.03 MAINTENANCE PRUNING TYPES

A. Both hazard reduction pruning and maintenance pruning shall consist of one or more of the following pruning types in accordance with ANSI A300:

1. Crown Cleaning: Crown cleaning shall consist of the selective removal of one or more of the following items: dead, dying, or diseased branches, weak branches, water sprouts and stubbed branches.
2. Crown Thinning: Crown thinning shall consist of the selective removal of branches to increase light penetration, air movement, and reduce weight.
3. Crown Raising: Crown raising shall consist of the removal of the lower branches of a tree to provide clearance.
4. Crown Reduction, or Crown Shaping: Crown reduction shall consist of decreasing the height and/or spread of a tree.
5. Vista Pruning: Vista pruning shall consist of selective thinning of framework limbs or specific areas of the crown.
6. Crown Restoration: Crown restoration pruning shall improve the structure, form and appearance of a tree which has been severely headed, vandalized, storm damaged or improperly pruned.

3.04 UTILITY PRUNING

A. Utility pruning shall consist of one or more of the following items:

1. Trees Underneath: Pruning trees growing directly under and growing into the facility/utility space.
2. Trees Along Side: Pruning of trees growing directly along side and growing into or toward the facility/utility space.

3.05 TREE REMOVAL

A. Trees indicated on the Drawings as "Remove" or trees tagged in the field by the Landscape Architect to be removed shall be felled.

1. Tags of each felled tree shall be saved and returned to the Architect.

B. Remove trees to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
3. Chip removed tree branches and dispose of off-site.

C. Fill depressions caused by tree removal 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 (200 mm), and compact each layer to a density equal to adjacent original ground.

D. Do not apply herbicide to remaining stumps or plant life to inhibit growth.

E. Burning shall not be permitted on-site.

3.06 TREE CABLING AND GUYING

A. Cabling and guying methods shall conform to ANSI A300, Best Management Practices Tree Support Systems: Cabling, Bracing, and Guying.

1. Provide cabling and guying systems to accomplish structural support of the tree as scheduled on the Drawings.

3.07 PRUNING GIRDLING ROOTS

A. Where specified in the schedule, the Contractor shall remove girdling roots from base of trees. Removal shall include sawing and splitting as required to remove roots.

3.08 VINE REMOVAL

A. Vines shall be removed from trees.

3.09 WIRE REMOVAL

A. Barbed wire and other wire shall be removed from trees.

3.10 DEADWOOD AND BRUSH REMOVAL

A. Deadwood and brush within the limits of work indicated on the Drawings shall be disposed of as follows:

1. Brush, limbs, and other material less than 6 in. in diameter shall be chipped and stockpiled on-site in an area designated by the Architect.
2. All deadwood shall be chipped and stockpiled as specified above.
3. Limbs 6 in. and larger shall, at the Contractor's option, be disposed of as follows:
   a. Material shall become the property of the Contractor and be disposed of off-site, or;
   b. Material shall be cut to 4 ft. lengths and stacked in an on-site location designated by the Architect.

B. All debris material not otherwise indicated shall be legally disposed of off-site.

3.11 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan

END OF SECTION

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

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 temporary excavation support and protection systems.

B. Related Requirements:

1. Section 312000 "Earth Moving" for excavating and backfilling, for controlling surface-water runoff and ponding, and for dewatering excavations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.

B. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Land surveyor.
2. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the Commonwealth of Pennsylvania.

B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

1.5 CLOSEOUT SUBMITTALS

A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect's written permission.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:

1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.
3. Compliance with requirements of authorities having jurisdiction.
4. Compliance with utility company requirements.
5. Compliance with railroad requirements.

2.2 MATERIALS

A. Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.

C. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

D. Tiebacks: Steel bars, ASTM A722/A722M.

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 that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

3.2 INSTALLATION - GENERAL

A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

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.

C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

3.3 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
3. Accurately align exposed faces of flanges to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds.

1. Trim excavation as required to install lagging.
2. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.4 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback, and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 MAINTENANCE

A. Monitor and maintain excavation support and protection system.

B. Prevent surface water from entering excavations by grading, dikes, or other means.

C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

3.7 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.

1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
2. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.8 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.

1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
2. Remove excavation support and protection systems to a minimum depth of 48 (1200) inches (mm) below overlying construction, and abandon remainder.
3. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
4. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION 315000