



# Christy Recreation Center- Renovation - Phase 1

City of Philadelphia, Department of Parks & Recreation

**CD SUBMISSION**

March 15, 2024

**SPECIFICATIONS**

Our work transforms the way people interact with each other and with their surroundings.

Project Manual – Technical Specifications

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## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.2 PROJECT INFORMATION

A. Project Identification: Christy Recreation Center, Phase 1 Renovations.

1. Project Location: 728 S 55th St, Philadelphia, PA 19143.
2. Owner: Philadelphia Parks & Recreation, City of Philadelphia.
3. Owner's Representative: Priyanka Malik, Project Manager, Philadelphia Parks & Recreation, (215) 421 0397.

B. Architect: SMP Architects, 1600 Walnut Street, 2<sup>nd</sup> Floor, Philadelphia, PA 19103.

#### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The project consists of a renovation of the Christy Recreation Center. This is Phase 1 of a two phased renovation project. The renovation will make significant modifications to the site surrounding the building, upgrade the building entrance area, and replace existing windows, The work consists of, but is not limited to: selective demolition; concrete work; landscape planting, grading, and paving; playground equipment; interior partition modifications; interior and exterior painting; doors, frames, and hardware; storefront, windows and glazing; resilient flooring; lighting and electrical work; HVAC work; and plumbing work.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

#### 1.4 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner may elect to award separate contract(s) for additional construction operations at the Project site, simultaneously or subsequent to the work on this contract. Work may include, but may not be limited to, the following.
  1. Exterior mural painting.
  2. Interior sculpture restoration and relocation.

#### 1.5 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations as indicated on Drawings.
- B. Use of Site: Do not disturb portions of Project site beyond areas in which the Work is indicated.
  1. 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.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

#### 1.6 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy portions of the existing building not impacted by construction. Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

#### 1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of the building, Monday through Friday, unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  1. Notify Owner not less than seven days in advance of proposed utility interruptions.
  2. Obtain Owner's written permission before proceeding with utility interruptions.

- D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- E. Restricted Substances: Use of tobacco products and other controlled substances within the existing building is not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
  - 3. The term "Owner" shall refer to the Philadelphia Department of Public Property, City of Philadelphia.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



## SECTION 011001 – SUPPLEMENTARY STATE GRANT CONDITIONS (RACP)

### PART 1 GENERAL

#### 1.1 SUPPLEMENTARY CONDITIONS

A. These Supplementary Conditions amend or supplement the “General Conditions” and other provisions of the Contract Documents as indicated below. All provisions, which are not so amended or supplemented, remain in full force and effect. The “General Conditions” also may be supplemented elsewhere in the Contract Documents by provisions located in, but not necessarily limited to, Division 1 of the specifications.

#### 1.2 STATE REQUIREMENTS FOR RACP GRANTS

A. The Contractor is hereby notified that state grant funds are being used to finance a portion of this construction and the Contractor shall therefore comply with the state requirements imposed by the Commonwealth of Pennsylvania.

B. If there are different types of state grants funding the construction, each grant will have a separate section in these specifications outlining the supplementary state conditions for that type of grant and Contractor is required to comply with the requirements of each and every type of grant. Please review the supplementary state condition sections carefully. Many of the state grant requirements will be duplicative, but there may be important differences.

C. The City was selected to receive a Redevelopment Assistance Capital Program grant (the “RACP Grant”) from the Commonwealth of Pennsylvania (the “Commonwealth”) to fund a portion of the Phase 1 renovation at Christy Recreation Center.

D. The Contractor is responsible for performing its work in accordance with the Commonwealth’s RACP requirements, which are included in this Section and which may be revised from time to time (the “RACP Requirements”). If the Contractor is not complying with the RACP Requirements, payment may be withheld from the Contractor. In the case of any differences between the RACP Requirements and the Contract Documents (including but not limited to prevailing wage requirements), the Contractor shall comply with the more stringent requirement.

E. Accordingly, in performing all work, including project management work, the Contractor shall:

1. Comply with the RACP Requirements, including the items listed on the “Key Compliance Guidelines” available at this link, and also Attachment 1.  
<https://www.budget.pa.gov/Programs/RACP/Documents/Key%20Compliance%20Guidelines.pdf>
2. Review and comply with the “Guidance on Steel Certification Relative to the Redevelopment Assistance Capital Program (RACP)” (Updated March 2023), Attachment 2.
3. Ensure that prevailing wage requirements under the Pennsylvania Prevailing Wage Act or the City of Philadelphia’s prevailing wage requirements, whichever are higher, are satisfied.

NOTE that the Contractor shall pay, and require to be paid, the current wage rates as those may be updated by the Commonwealth or the City from time to time.

4. The Contractor shall submit wage information on the Commonwealth's wage rate submittal form (the "DLI Wage Form"), Attachment 3.

5. Indemnify, defend, and hold harmless, and cause its subcontractors to indemnify, defend, and hold harmless, the Commonwealth, in addition to the City of Philadelphia, from and against all claims, liabilities, demands and actions based upon or arising in whole or in part, directly or indirectly, from or in any way related to any activities performed in connection with the work.

6. Add, and require subcontractors to add, the Commonwealth as an additional insured, in addition to the City of Philadelphia, on any insurance policies. NOTE that the insurance requirements stated in the attached Key Compliance Guidelines may be lower than those otherwise required for the Project. If there is a difference, the Contractor is required to obtain the higher limits and types of insurance.

7. Certify, in writing, for itself and all its subcontractors, that as of the date of its execution of this contract that neither the Contractor, nor any subcontractors, nor any suppliers, are under suspension or debarment by the Commonwealth or any governmental entity, instrumentality, or authority and, if the Contractor cannot so certify, then it agrees to submit, along with the bid/proposal, a written explanation of why such certification cannot be made.

8. Certify, in writing, that as of the date of its execution of the contract, the Contractor has no tax liabilities or other Commonwealth obligations.

9. Execute, and require all subcontractors who work on the Project to execute, the Commonwealth's "Nondiscrimination/Sexual Harassment Clause" (Attachment 4) as though the Contractor or subcontractor, as the case may be, were the "Applicant" or "Grantee" for purposes of that form.

PART 2 PRODUCTS – Not Used.

PART 3 EXECUTION – Not Used.

END OF SECTION

## KEY COMPLIANCE GUIDELINES

It is suggested that a copy of this complete document be given to your Project, Construction Manager, and/or Architect so that they are fully aware of the RACP requirements related to each. This document should be included in your bid packages and should be made an addendum to any and all construction contracts, plans and specifications related to the RACP project.

Compliance with all RACP requirements, including the key items in these guidelines will be monitored frequently throughout the construction phase of your project and will be reviewed once more during the legislatively mandated close-out audit.

## COMPETITIVE BIDDING REQUIREMENTS

The sole and exclusive bidding requirement for RACP projects is in the Capital Facilities Debt Enabling Act (Act 67 of 2004), which states "Notwithstanding any other provision of law, the solicitation of a minimum of three written bids for all contracted construction work on redevelopment assistance capital projects shall be the sole requirement for the composition, solicitation, opening and award of bids on such projects." Unless the terms of the law change, the Office of the Budget cannot grant waivers for bidding requirements to Grantees.

RACP projects are not subject to separation of trades. You are REQUIRED to solicit a minimum of three (3) bids for "all generally contracted work" being performed within the RACP defined scope of work. You are not required to receive three (3) bid responses. However, you should provide documentation to prove that at least three bids were solicited by providing copies of the solicitation letters (preferably on letterhead of the bidding entity) used in the bidding process. You are not required to select the lowest bidder, but if you do not, you will have to provide a brief written justification for your selection. Note: there is NO threshold level under the RACP program regardless of the size or dollar amount associated with the work to be performed. You need to show that you solicited a minimum of three (3) bids for any contract to be eligible for RACP.

Bidding is acceptable at either the general contractor level (described in option a. below) or at the sub-contractor level (described in option b. below):

- **General Contractor (GC) Level** - If you chose to bid at the GC level, please note that the bid should encompass the entire RACP scope of work to be performed including all associated construction work. The dollar amount bid on the project must include 100% of the work to be performed by the GC and the sub-contractors. Bidding at the GC level will require submission of bidding and construction related documents at the GC level only (see Sub-Contractor level below for a distinction)
- **Sub-Contractor Level** - If you choose not to solicit three bids for a General Contractor, then you are required to solicit a minimum of three bids for EACH Sub-Contractor covering all trades involved in the project. Note that any self-performed work by a non-bid GC is NOT an eligible cost for reimbursement OR match purposes. Bidding at the Sub-Contractor level will require submission of bidding and construction related documents at the sub level...meaning proof of

bidding, construction contracts, payment and performance bonds, insurance etc. will need to be provided for every sub-contractor in the RACP scope.

Professional Services: Professional services associated with the project are not required to be bid as these associated costs are only eligible as match.

Change Orders: Grantees and/or Sub-Grantees are not required to competitively bid out change orders as long as the work was within the RACP scope of the original bid and is less than 20% of the total contract. If a change order is for work beyond the RACP scope of work originally bid, the Grantee will be required to competitively bid out the new scope of work in order to be considered RACP eligible.

## **PENNSYLVANIA STEEL PRODUCTS PROCUREMENT ACT**

The Office of the Budget (OB) cannot grant waivers to the Pennsylvania Steel Products Procurement Act (SPPA) unless the terms of the law change. All RACP Grantees must comply with the SPPA. If a Grantee/RACP project fails to abide by the SPPA, it does so at its own risk.

[A full explanation on the RACP steel requirements is available as a PDF download.](#)

Up to 2011, OB only accepted the ST-4 Form (justification for the use of foreign steel) that the Department of General Services (DGS) had exclusively devised to address exceptions linked to the requirements of the SPPA, when it was necessary. Since 2011, OB has approved the acceptability of two more DGS ST Forms (ST-2, ST-3) with some caveats, providing that the forms are properly filled out. The ST-1 Form will not be accepted by OB. It is not necessary for the ST-2, ST-3, and ST-4 Forms to be notarized.

Since 2013, OB has utilized the DGS Exempt Machinery and Equipment Steel Products listings ([2024](#), [2023](#), [2022](#)) as part of the RACP steel policy. DGS published a Statement of Policy - Steel Products Procurement in the Pennsylvania Bulletin Volume 43, Number 6 dated February 9, 2013 (See PA Bulletin #43, pages 85-86) that discussed their production of an annual list, based on their analysis of submitted ST-4 forms, which exempts certain steel products not produced domestically in sufficient quantity. DGS publishes an updated "Exemption List" annually.

Please be aware that ST forms are acceptable only in cases where nonstructural steel needs to be addressed. The DGS ST forms do not replace the steel certification forms associated with structural steel. OB will continue to require the submission of steel mill certifications to demonstrate compliance with the steel requirements for structural steel.

The PDF copies of the three acceptable ST Forms for RACP listed below can be obtained from the RACP website:

- [ST-2 Steel Origin Certification: Non-Identifiable, Non-Structural Steel](#)
- [ST-3 75% U.S. Manufacture Certification](#)
- [ST-4 Not Domestically Manufactured: Prime Contractor](#) (only to be used when requesting items to be exempted that are not found on the current year's List of Exempt Machinery and Equipment Steel Products)

It is suggested that the certifications be collected at the time any steel for the project is purchased and delivered to ease the collection process.

Be advised that OB DOES NOT need to approve the ST forms prior to the start of the construction period. The ST forms need to be submitted to demonstrate that compliance, when and where necessary, has been met.

We shall deem as ineligible all contracts that are unable to demonstrate compliance via the submission of steel certifications for Structural Steel and for Non-structural Steel the submission of steel certifications and/or ST forms and/or DGS Exempt Machinery and Equipment Steel Products List. Therefore, the value of construction contracts associated with non-compliant steel will be removed (both materials and labor costs) from the scope of the project, which may in turn affect the project's ability to leverage their full grant amount (project may not receive its full grant).

Recycled products, melted from previously used steel, are acceptable, providing that adequate documentation from the supplier has been furnished. The supplier shall certify that the recycled steel product was produced in the USA.

## TRADE PRACTICES ACT

In accordance with the Trade Practices Act of July 23, 1968, P.L. 686 (71 P.S. § 773.101 et seq.), the Grantee cannot and shall not use or permit to be used in the work any aluminum or steel products made in a foreign country which is listed below as a foreign country which discriminates against aluminum or steel products manufactured in Pennsylvania. The countries of Argentina, Brazil, South Korea, and Spain have been found to discriminate against certain products manufactured in Pennsylvania. Therefore, the purchase or use of those countries' products, as listed below, is not permitted:

- **Argentina:** carbon steel wire rod and cold-rolled carbon steel sheet.
- **Brazil:** welded carbon steel pipes and tubes; carbon steel wire rod; tool steel; certain stainless steel products, including hot-rolled stainless steel bar; stainless steel wire rod and cold-formed stainless steel bar; pre-stressed concrete steel wire strand; hot-rolled carbon steel plate in coil; hot-rolled carbon steel sheet; and cold-rolled carbon steel sheet.
- **South Korea:** welded carbon steel pipes and tubes; hot-rolled carbon steel plate; hot-rolled carbon steel sheet; and galvanized steel sheet.
- **Spain:** certain stainless steel products, including stainless steel wire rod, hot-rolled stainless steel bars; and cold-formed stainless steel bars; pre-stressed concrete steel wire strand; and certain steel products, including hot-rolled steel plate, cold-rolled carbon steel plate, carbon steel structural shapes; galvanized carbon steel sheet, hot-rolled carbon steel bars, and cold-formed carbon steel bars.

Penalties for violation of the above paragraphs may be found in the Trade Practices Act, which penalties include becoming ineligible for public works contracts for a period of three years.

This provision in no way relieves the Grantee of responsibility to comply with those provisions which prohibit the use of foreign-made steel and cast iron products.

### **PUBLIC WORKS CONTRACTORS' BOND LAW (PAYMENT & PERFORMANCE BONDS)**

The requirement for 100% payment and performance (P&P) bonds is a state law; the Office of the Budget cannot waive this requirement.

A performance bond must be obtained at 100% of the contract amount, conditioned upon the faithful performance of the contract in accordance with the plans, specifications, and conditions of the contract. Such bond shall be solely for the protection of the contracting body which awarded said contract.

A payment bond must be obtained at 100% of the contract amount. Such bond shall be solely for the protection of claimants supplying labor or materials to the Grantee, its contractor or to any of its subcontractors, in the prosecution of the work provided for in such contract, and shall be conditioned for the prompt payment of all such material furnished or labor supplied or performed in the prosecution of the work. "Labor or materials" shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the site.

### **PA PREVAILING WAGE ACT (PWA)**

The Office of the Budget cannot grant waivers for the PA Prevailing Wage Act. All Grantees must comply with the act. Grantees that fail to abide by the Prevailing Wage Act do so at their own risk. Please do not assume that PA Prevailing Wage is always consistent with your local union wages.

All projects should apply for a wage determination letter prior to the start of construction by registering the project with the PA Department of Labor and Industry to obtain the prevailing wage rates relevant to your project. This determination sheet will provide the necessary trade classifications for the project, along with their corresponding hourly wage and hourly fringe rates that are required for the certified payrolls required as part of RACP. The wage determination should be obtained within 120 days of the award of construction contracts. If necessary, the Department of Labor and Industry can issue determinations letters after construction has begun.

The prevailing wage information and forms can be found on the [PA Department of Labor & Industry website](#).

### **AMERICANS WITH DISABILITIES ACT (ADA)**

Typically your architect should provide a letter stating the plans and specs are in compliance with ADA regulations. Additionally, the Grantee agrees to comply with the General Prohibitions Against Discrimination, 28 C.F.R. § 35.130, and all other regulations promulgated under Title II of The Americans with Disabilities Act which are applicable to all benefits, services, programs, and activities provided by the commonwealth through contracts.

### **FIDELITY BONDS**

The Grantee shall procure and furnish evidence to OB, of fidelity bonds with coverage to be maintained under the administrative title of the position, in amounts and for such positions as are reasonably

determined by OB. Fidelity Bonding is also commonly known as "Employee Dishonesty Insurance." Grantees should submit certificates of insurance to support fidelity bond coverage is in effect and the coverage amount meets or exceeds the RACP grant amount, or the coverage amount meets or exceeds the monthly project funding schedule contained in Appendix C of the grant agreement. For Grantees with multiple projects and/or grants larger than \$5,000,000 the coverage amount can be the lesser of either \$1,000,000 or 20% of the RACP grant amount(s).

### **INSURANCE REQUIREMENTS**

- Worker's Compensation Insurance - The Grantee shall provide Worker's Compensation Insurance where required, and shall accept full responsibility for the payment of premiums for Worker's Compensation Insurance and Social Security, as well as income tax withholding and any other taxes or payroll deductions required by law for its employees who are performing services related to the project.
- General Liability & Property Damage Insurance - The Grantee will provide and maintain comprehensive general liability and property damage insurance in the minimum amount of \$250,000.00 per person for injury and death in a single occurrence; \$1,000,000.00 per occurrence for injury or death of more than one (1) person in a single occurrence; and \$500,000.00 for a single occurrence of property damage, and which shall be endorsed to protect the commonwealth.
- Flood Insurance – If the project is wholly or partially within a floodplain, proof of sufficient flood insurance coverage must be provided. In any case, a project is required to provide a copy of a floodplain map of the project area, with the project site being delineated thereon.

*Identify Commonwealth as Additional Insured:* The commonwealth shall be listed on the above insurance policies as an additional insured. Upon request, the Grantee shall furnish proof of insurance as required by this section to OB.

### **RESTRICTIONS ON GOVERNMENTAL ENTITIES SELLING RACP PROJECTS**

Article 8 of the RACP Grant Agreement spells out sale price restrictions for a governmental entity that sells property that was acquired and/or improved with RACP funds. The restrictions are required to insure that the Grantees CANNOT sell the property for a net gain or even recoup the value of the grant in the sale price. [A PDF download is available that contains more information on Article 8.](#)

## ATTACHMENT 2

### **GUIDANCE ON STEEL CERTIFICATION RELATIVE TO THE REDEVELOPMENT ASSISTANCE CAPITAL PROGRAM (RACP)**

*Updated March 2023*

The following guidance is a clarification from the Office of the Budget (OB) regarding the requirements associated with the Pennsylvania Steel Products Procurement Act (SPPA) relative to the RACP program whose statutes are regulated under Act 1 of 1999, as amended. In the past, many a grantee has inquired about specific cases and we were able to provide each individual project with specific directions. Additionally, we had only accepted the ST-4 form that the Department of General Services (DGS) had exclusively devised to address exceptions linked to the requirements of the SPPA in the handling of special cases or exceptions. Please note that cost consideration (or convenience) is not an acceptable justification that the ST-4 form can address. Filled out ST-4 forms premised on cost consideration will not be accepted by OB.

Effective immediately, OB will accept two more DGS ST forms (ST-2, ST-3) with some caveats, providing that the forms are properly filled out. The ST-1 form is NOT a valid option and shall NOT be accepted by OB. It is not necessary for the ST-2, ST-3, and ST-4 forms to be notarized. Please, be advised that this guidance is specifically tailored to suit the published and programmatic needs of OB as the overseer of RACP program. This is not a commonwealth-wide policy. Any attempt to impose this guidance on other state agencies is strongly discouraged.

Please, be aware that the aforementioned ST forms are acceptable only in cases where non-structural steel needs to be addressed. The DGS ST forms do not replace the steel certification forms associated with structural steel. It remains the responsibility of the project representatives to provide documented evidence that a non-structural steel product is not domestically produced in sufficient quantities.

OB shall continue to require that steel mill certifications be submitted to demonstrate compliance with the steel requirements. Please, be further advised that OB DOES NOT need to approve the ST forms prior to the start of the construction period. The ST forms need to be submitted to demonstrate that compliance, when and where necessary, has been met. The ST forms exceptions are displayed below. Please, contact us if you have any questions.

It is suggested that the certifications be collected at the time any steel for the project is purchased and delivered to ease the collection process.

Effective January 1, 2013 OB began utilizing the DGS Exempt Machinery and Equipment Steel Products listings as part of the RACP steel policy. DGS published a Statement of Policy - Steel Products Procurement in the Pennsylvania Bulletin Volume 43, Number 6 dated February 9, 2013 (See PA Bulletin #43, pages 85-86) that discussed their production of an annual list, based on their analysis of submitted ST-4 forms, which exempts certain steel products not produced domestically in sufficient quantity.

No other changes in RACP steel policy resulted from this new adjustment; consequently, the use of steel certificates for structural steel will still be required. Please note that the use of ST 2, 3, and 4, as requested for other steel products, will still be utilized unless an exemption based on the list has been formulated and forwarded to OB.

RACP Policy for Compliance with the Steel Products Procurement Act:



Two distinct approaches are presented below:

#### Structural Steel Products

Pursuant to the SPPA, OB will require a mill certificate containing the statement "milled, melted, and manufactured in the USA" for all structural steel products used on RACP projects. We shall deem as ineligible all contracts that are unable to demonstrate compliance via the submission of steel certifications. Therefore, the value of construction contracts associated with non-compliant steel will be removed (both materials and labor costs) from the scope of the project.

#### Non-Structural Steel Products

Pursuant to the SPPA, OB will require, either, a mill certificate containing the statement "milled, melted, and manufactured in the USA" or the appropriate ST form or an **Exemption Request** to utilize the DGS current years' Final List of Exempt Machinery and Equipment Steel Products to demonstrate compliance associated with the non-structural steel products used on RACP projects. OB shall deem as ineligible all contracts that are unable to demonstrate compliance via the submission of steel certifications /**ST forms/Exemption Request** based on the DGS Exempt Machinery and Equipment Steel Products listing. Therefore, the value of construction contracts associated with non-compliant steel will be removed (both materials and labor costs) from the scope of the project.

Recycled products, melted from previously used steel, are acceptable, providing that adequate documentation from the supplier has been furnished. The supplier shall certify that the recycled steel product was produced in the USA.

Furthermore, the burden of proof for all non-structural steel products not produced domestically in sufficient quantities is still the project's responsibility to provide.

Please be aware that the acceptance of ST forms is contingent upon the form being fully filled-in and compliant with the submission guidelines for steel certifications for DGS projects (see attached) with the following exceptions:

- A. It is not necessary for the forms to be notarized; however, all ST forms must be signed. Original signatures or electronic signatures through Adobe fill/sign, DocuSign, or Nuance (program which allows electronic signature similar to Adobe fill/sign) are acceptable.
- B. Any questions regarding steel certification submissions and/or compliance with the Act shall be submitted to OB (Scott Bowman - [scotbowman@pa.gov](mailto:scotbowman@pa.gov)).
- C. The Steel certification forms do NOT need to be submitted and approved by OB before the steel product arrives on site so as not to interfere with the project construction schedule.
- D. OB assumes responsibility for acceptance of the DGS ST forms in accordance with this policy.

Completion of the ST-2, ST-3, and ST-4 forms shall follow the DGS directions attached to the form with the following exceptions:

- o ST forms do NOT need to be submitted and approved by OB before the steel product arrives on site so as not to interfere with the construction schedule.

- o RACP ME# assigned to the project shall be inserted in all areas requiring the DGS contract number (Line#5).
- o RACP official project name shall be inserted in all areas requiring the contract title (Line #6).

Note:

Acceptance of each ST form shall be determined by OB at its sole discretion. All documents and other information to be delivered in order to demonstrate compliance with the steel requirements shall be and are, in form, content and substance, subject to the approval of OB, which approval may be withheld or delayed at OB's discretion. OB reserves the right to reject all improperly filled out or unsupported ST forms.

Below are links to PDF copies of the three acceptable ST Forms that can be obtained from the RACP website:

- [ST-2 Steel Origin Certification: Non-Identifiable, Non-Structural Steel](#)
- [ST-3 75% U.S. Manufacture Certification](#)
- [ST-4 Not Domestically Manufactured: Prime Contractor](#) (only to be used when the items requested to be exempted are not found on the appropriate year's List of Exempt Machinery and Equipment Steel Products [see section below entitled "Year of DGS Exemption Listing to Use"])

To implement the RACP policy on Non-structural Steel Exemption Request utilizing the DGS's current years' Final List of Exempt Machinery and Equipment Steel Products, referred to as the "Exemption List", please follow the below requirements:

1. The Project must be under "active" construction (workers on site) on or AFTER 1/01/2013 (RACP effective date) to use the "Exemption List".
2. "Active" construction does not include performance of just "punch list" items.
3. Effective date is based on the "active" construction date and not the date the machinery and equipment were purchased.
4. There is no retroactive application of utilization of the "Exemption List".
5. No ST-4 form is required for a RACP Exemption Request based on the "Exemption List".
6. RACP Exemption Request (to utilize the "Exemption List") must come from a contractor involved in the construction of the project and be:
  - On Construction Company Letterhead.
  - Dated and Signed by appropriate company official (does not need to be notarized).
  - Should be addressed to Office of Budget
  - Should contain RACP project name and/or ME #
  - Lists any/all machinery and equipment that the Company is requesting to have exempted from ST-4 documentation.
  - All items listed on RACP Exemption Request letter must clearly match-up to an item on the appropriate year's "Exemption List" and the Exemption List year should be notated for each item.
  - There can/may be multiple construction company RACP Exemption Request letters utilized for various machinery and equipment, as applicable, per project.
  - Exemption Request can be submitted directly by the project to OB or through the State Assigned Consultant for their project.

- Any questions regarding the exemption request submission and/or compliance with the SPPA shall also be submitted to OB, to the attention of Scott Bowman, [Scotbowman@pa.gov](mailto:Scotbowman@pa.gov)

Year of DGS Exemption Listing to Use:

A project should be using the exemption listing for when they are in active construction. For example, if construction was active (and complete) in 2019 they would use the 2019 listing. If a project overlaps a calendar year, they should use the latest listing in which construction is active. For example, if construction is active in 2019 and 2020, they would use the 2020 listing.

If a project is phased, they should use the listing for the year they are in active construction for each phase. For example, if the first phase starts and ends in 2020 whereas the second phase starts and ends in 2021, the first phase would use the 2020 listing while the second phase would use the 2021 listing. If a phase overlaps a calendar year, follow the 1<sup>st</sup> paragraph above.

Among other items, the DGS web page for Steel Products Procurement Act information includes links for a copy of the Act; the current year's Final List of Exempt Machinery and Equipment Steel Products; the PA Bulletin's Steel Products Procurement Act Statement of Policy; and Frequently Asked Questions. Certain prior years DGS Exemption Lists are downloadable from the RACP website.

Please be aware that all other steel items not specifically exempted or that may require any type of interpretation would be discretionary to OB's policy. Be reminded that this exemption listing is not effective for structural steel.

Note:


Acceptance of each Exemption Request shall be determined by OB at its sole discretion. All documents and other information to demonstrate compliance with the steel requirements shall be in form, content, and substance, subject to the approval of OB, which approval may be withheld or delayed at OB's discretion. OB reserves the right to reject all improperly filled out or unsupported Exemption Request.

ATTACHMENT 3

WEEKLY PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

Contractor or  Subcontractor (Please check one)

ALL INFORMATION MUST BE COMPLETED

CONTRACTOR ADDRESS		SUBCONTRACTOR ADDRESS		 DEPARTMENT OF <b>LABOR &amp; INDUSTRY</b> <small>COMMONWEALTH OF PENNSYLVANIA</small> BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGE DIVISION 7TH & FORSTER STREETS HARRISBURG, PA 17120 1-800-932-0665
PAYROLL NUMBER	WEEK ENDING DATE	PROJECT AND LOCATION PROJECT SERIAL # PROJECT #		

EMPLOYEE NAME	APPR. RATE (%)	WORK CLASSIFICATION	DAY AND DATE							S-TIME 0-TIME	BASE HOURLY RATE	TOTAL FRINGE BENEFITS (C=Cash) (FB=Contributions)*	TOTAL DEDUCTIONS	GROSS PAY FOR PREVAILING RATE JOB(S)	CHECK #
			HOURS WORKED EACH DAY												

\*SEE REVERSE SIDE

PAGE NUMBER \_\_\_\_\_ OF \_\_\_\_\_

**THE NOTARIZATION MUST BE COMPLETED ON FIRST AND LAST SUBMISSIONS ONLY. ALL OTHER INFORMATION MUST BE COMPLETED WEEKLY.**

\*FRINGE BENEFITS EXPLANATION (FB): Bona fide benefits contribution, except those required by Federal or State Law (unemployment tax, workers' compensation, income taxes, etc.)

Please specify the type of benefits provided and contributions per hour:

- 1) Medical or hospital care \_\_\_\_\_
- 2) Pension or retirement \_\_\_\_\_
- 3) Life insurance \_\_\_\_\_
- 4) Disability \_\_\_\_\_
- 5) Vacation, holiday \_\_\_\_\_
- 6) Other (please specify) \_\_\_\_\_

**CERTIFIED STATEMENT OF COMPLIANCE**

1. The undersigned, having executed a contract with \_\_\_\_\_  
(AWARDING AGENCY, CONTRACTOR OR SUBCONTRACTOR)

\_\_\_\_\_ for the construction of the above-identified project, acknowledges that:

- (a) The prevailing wage requirements and the predetermined rates are included in the aforesaid contract.
- (b) Correction of any infractions of the aforesaid conditions is the contractor's or subcontractor's responsibility.
- (c) It is the contractor's responsibility to include the Prevailing Wage requirements and the predetermined rates in any subcontract or lower tier subcontract for this project.

2. The undersigned certifies that:

- (a) Neither he nor his firm, nor any firm, corporation or partnership in which he or his firm has an interest is debarred by the Secretary of Labor and Industry pursuant to Section 11(e) of the PA Prevailing Wage Act, Act of August 15, 1961, P.L. 987 as amended, 43 P.S. § 165-11(e).
- (b) No part of this contract has been or will be subcontracted to any subcontractor if such subcontractor or any firm, corporation or partnership in which such subcontractor has an interest is debarred pursuant to the aforementioned statute.

3. The undersigned certifies that:

(a) the legal name and the business address of the contractor or subcontractor are: \_\_\_\_\_  
 \_\_\_\_\_

(b) The undersigned is:  a single proprietorship  a corporation organized in the state of \_\_\_\_\_  
 a partnership  other organization (describe) \_\_\_\_\_

(c) The name, title and address of the owner, partners or officers of the contractor/subcontractor are:

NAME	TITLE	ADDRESS

The willful falsification of any of the above statements may subject the contractor to civil or criminal prosecution, provided in the PA Prevailing Wage Act of August 15, 1961, P.L. 987, as amended, August 9, 1963, 43 P.S. § 165.1 through 165.17.

\_\_\_\_\_  
 (DATE)

\_\_\_\_\_  
 (SIGNATURE)

\_\_\_\_\_  
 (TITLE)

\_\_\_\_\_  
 SEAL

Taken, sworn and subscribed before me this \_\_\_\_\_ Day  
 of \_\_\_\_\_ A.D., \_\_\_\_\_

**Commonwealth of Pennsylvania**  
**NONDISCRIMINATION/SEXUAL HARASSMENT CLAUSE**

During the term of the Contract, the Applicant (known herein as “Grantee”) agrees as follows:

1. In the hiring of any employee(s) for the manufacture of supplies, performance of work, or any other activity required under the grant agreement or any subgrant agreement, contract, or subcontract, the Grantee, a subgrantee, a contractor, a subcontractor, or any person acting on behalf of the Grantee shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the *Pennsylvania Human Relations Act* (PHRA) and applicable federal laws, against any citizen of this Commonwealth who is qualified and available to perform the work to which the employment relates.
2. The Grantee, any subgrantee, contractor or any subcontractor or any person on their behalf shall not in any manner discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against or intimidate any of its employees.
3. Neither the Grantee nor any subgrantee nor any contractor nor any subcontractor nor any person on their behalf shall in any manner discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, in the provision of services under the grant agreement, subgrant agreement, contract or subcontract.
4. Neither the Grantee nor any subgrantee nor any contractor nor any subcontractor nor any person on their behalf shall in any manner discriminate against employees by reason of participation in or decision to refrain from participating in labor activities protected under the *Public Employee Relations Act*, *Pennsylvania Labor Relations Act* or *National Labor Relations Act*, as applicable and to the extent determined by entities charged with such Acts’ enforcement, and shall comply with any provision of law establishing organizations as employees’ exclusive representatives.
5. The Grantee, any subgrantee, contractor or any subcontractor shall establish and maintain a written nondiscrimination and sexual harassment policy and shall inform their employees in writing of the policy. The policy must contain a provision that sexual harassment will not be tolerated and employees who practice it will be disciplined. Posting this Nondiscrimination/Sexual Harassment Clause conspicuously in easily-accessible and well-lighted places customarily frequented by employees and at or near where the grant services are performed shall satisfy this requirement for employees with an established work site.
6. The Grantee, any subgrantee, contractor or any subcontractor shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against any subgrantee, contractor, subcontractor or supplier who is qualified to perform the work to which the grant relates.
7. The Grantee and each subgrantee, contractor and subcontractor represents that it is presently in compliance with and will maintain compliance with all applicable federal, state, and local laws and regulations relating to nondiscrimination and sexual harassment. The Grantee and each subgrantee, contractor and subcontractor further represents that it has filed a Standard Form 100 Employer Information Report (“EEO-1”) with the U.S. Equal Employment Opportunity Commission (“EEOC”) and shall file an annual EEO-1 report with the EEOC as required for employers’ subject to *Title VII of the Civil Rights Act of 1964*, as amended, that have 100 or more employees and employers that have federal government contracts or first-tier subcontracts and have 50 or more employees. The Grantee, any subgrantee, any contractor or any subcontractor shall, upon request and within the time periods

requested by the Commonwealth, furnish all necessary employment documents and records, including EEO-1 reports, and permit access to their books, records, and accounts by the granting agency and the Bureau of Diversity, Inclusion and Small Business Opportunities for the purpose of ascertaining compliance with the provisions of this Nondiscrimination/Sexual Harassment Clause.

8. The Grantee, any subgrantee, contractor or any subcontractor shall include the provisions of this Nondiscrimination/Sexual Harassment Clause in every subgrant agreement, contract or subcontract so that those provisions applicable to subgrantees, contractors or subcontractors will be binding upon each subgrantee, contractor or subcontractor.
9. The Grantee's and each subgrantee's, contractor's and subcontractor's obligations pursuant to these provisions are ongoing from and after the effective date of the grant agreement through the termination date thereof. Accordingly, the Grantee and each subgrantee, contractor and subcontractor shall have an obligation to inform the Commonwealth if, at any time during the term of the grant agreement, it becomes aware of any actions or occurrences that would result in violation of these provisions.
10. The Commonwealth may cancel or terminate the grant agreement and all money due or to become due under the grant agreement may be forfeited for a violation of the terms and conditions of this Nondiscrimination/Sexual Harassment Clause. In addition, the granting agency may proceed with debarment or suspension and may place the Grantee, subgrantee, contractor, or subcontractor in the Contractor Responsibility File.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Company Name

## SECTION 012100 - ALLOWANCES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
  - 1. Lump-sum allowances.

#### 1.2 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.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

#### 1.5 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.

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: Lump-Sum Allowance: Include the sum of \$45,000 for Philadelphia Parks & Recreation standard exterior signage elements (9 signs) as documented on the landscape architecture drawings.
  - 1. This allowance includes material, receiving, handling, and installation costs, and Contractor overhead and profit.

END OF SECTION 012100

## SECTION 012300 - ALTERNATES

### PART 1 - GENERAL

#### 1.1 SUMMARY

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

#### 1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

#### 1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Sunshade Structure #1
  - 1. Base Bid: No sunshade structures provided.
  - 2. Alternate (Add): Provide Sunshade Structure #1, as documented on the landscape architecture drawings.
- B. Alternate No. 2: Sunshade Structure #2
  - 1. Base Bid: No sunshade structures provided.
  - 2. Alternate (Add): Provide Sunshade Structure #2, as documented on the landscape architecture drawings.

C. Alternate No. 3: Stormwater Management Alternate SMP-1-ALT

1. Base Bid: Provide SMP-1, as documented on the civil drawings.
2. Alternate (Add): Provide SMP-1-ALT, as documented on the civil drawings. This alternate will only become necessary if the results of required infiltration testing do not support the installation of the Base Bid SMP-1.

END OF SECTION 012300

## SECTION 012500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 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.

#### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 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 Authority Having Jurisdiction.
  - 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.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 14 days of receipt of request, or 7 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.
- 1.4 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.
- 1.5 PROCEDURES
- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.
- 1.6 SUBSTITUTIONS
- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 14 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. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. 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: Not allowed unless otherwise indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

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

#### 1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 or Architect's standard form.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.

#### 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 7 days, when not otherwise specified, 7 after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

#### 1.4 CHANGE ORDER PROCEDURES

- A. Change order procedures will follow Philadelphia Parks & Recreation (PPR) and Philadelphia Redevelopment Authority (PRA) standards.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600



## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. RFIs.
  - 4. Digital project management procedures.
  - 5. Project meetings.

#### 1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Contractor seeking information required by or clarifications of the Contract Documents.

#### 1.3 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.
  - 4. Coordinate closely with other contractors and third-party providers engaged by the Owner.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.

3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

#### 1.4 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. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. 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.
- 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-alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. 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.

1.5 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 so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Contractor's standard form submitted in electronic mail format, if acceptable to Owner and Architect. Provide electronic mail copy to Architect and Owner's project manager.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 4:00 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 10 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. 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.
- 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.
- 1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES
- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model and/or CAD drawings 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. Contractor shall execute a data licensing agreement on Architect's and/or their consultants' standard forms.

B. 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.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.

1. Agenda: Discuss items of significance that could affect progress, including the following:
  - a. Responsibilities and personnel assignments.
  - b. Tentative construction schedule.
  - c. Critical work sequencing and long lead items.
  - d. Designation of key personnel and their duties.
  - e. Lines of communications.
  - f. Use of web-based Project software.
  - g. Procedures for processing field decisions and Change Orders.
  - h. Procedures for RFIs.
  - i. Procedures for testing and inspecting.
  - j. Procedures for processing Applications for Payment.
  - k. Distribution of the Contract Documents.
  - l. Submittal procedures.
  - m. Preparation of Record Documents.
  - n. Use of the premises and existing building.

- o. Work restrictions.
  - p. Working hours.
  - q. Owner's occupancy requirements.
  - r. Responsibility for temporary facilities and controls.
  - s. Procedures for moisture and mold control.
  - t. Procedures for disruptions and shutdowns.
  - u. Construction waste management and recycling.
  - v. Parking availability.
  - w. Office, work, and storage areas.
  - x. Equipment deliveries and priorities.
  - y. First aid.
  - z. Security.
  - aa. Progress cleaning.
2. Minutes: Contractor shall record and distribute meeting minutes.
- C. 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 of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.

- i. Possible conflicts.
  - j. Compatibility requirements.
  - k. Time schedules.
  - l. Weather limitations.
  - m. Manufacturer's written instructions.
  - n. Warranty requirements.
  - o. Compatibility of materials.
  - p. Acceptability of substrates.
  - q. Temporary facilities and controls.
  - r. Space and access limitations.
  - s. Regulations of authorities having jurisdiction.
  - t. Testing and inspecting requirements.
  - u. Installation procedures.
  - v. Coordination with other work.
  - w. Required performance results.
  - x. Protection of adjacent work.
  - y. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how

construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period.
- b. Review present and future needs of each entity present, including the following:
- 1) Interface requirements.
  - 2) Sequence of operations.
  - 3) Status of submittals.
  - 4) Deliveries.
  - 5) Off-site fabrication.
  - 6) Access.
  - 7) Site use.
  - 8) Temporary facilities and controls.
  - 9) Progress cleaning.
  - 10) Quality and work standards.
  - 11) Status of correction of deficient items.
  - 12) Field observations.
  - 13) Status of RFIs.
  - 14) Status of Proposal Requests.
  - 15) Pending changes.
  - 16) Status of Change Orders.
  - 17) Pending claims and disputes.
  - 18) Documentation of information for payment requests.
3. Minutes: Contractor will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Submittal schedule requirements.
  - 2. Administrative and procedural requirements for submittals.

#### 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."

#### 1.3 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.

#### 1.4 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. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

#### 1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
2. Web-Based Project 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.

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.

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 14 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. Resubmittal Review: Allow 14 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

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.

#### 1.6 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 concurrent 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 (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
- C. Samples: Submit Samples for review of kind, 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 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. 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.
6. 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 one 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.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned.
    - 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:
- 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 Welding Procedure Specification and Procedure Qualification Record 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 primers and substrate preparation needed for adhesion.
  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.

#### 1.7 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, 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.

#### 1.8 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. 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.

#### 1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, 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 discard 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 013300

## SECTION 013516 - ALTERATION PROJECT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes special procedures for alteration work.

#### 1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

#### 1.3 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

#### 1.4 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- B. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- C. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

#### 1.5 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
  - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
  - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner.
  - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
  - 1. Repair and clean items for reuse as indicated.
  - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
  - 1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
  - 2. Secure stored materials to protect from theft.

3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
  1. Use only proven protection methods, appropriate to each area and surface being protected.
  2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
  3. Erect temporary barriers to form and maintain fire-egress routes.
  4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
  5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
  6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
  7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
  8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
  1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
  2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
  1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
  2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.

3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
  2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- 3.2 PROTECTION FROM FIRE
- A. General: Follow fire-prevention plan and the following:
1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties titled "Owner's Responsibility for Fire Protection."
  2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
    - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Notify Owner before each occurrence, indicating location of such work.
  2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
  3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
  5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

- a. Train each fire watch in the proper operation of fire-control equipment and alarms.
  - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
  - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
  - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.
- 3.3 GENERAL ALTERATION WORK
- A. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
  - B. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
    1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 013516

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and 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. 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.
  - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.2 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: 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 trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. 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.
- E. 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.
- F. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

- H. 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.
- I. 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.

### 1.3 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.
- 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.

### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.5 INFORMATIONAL SUBMITTALS

- A. 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.
- B. 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.

### 1.6 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. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. 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. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

## 1.7 QUALITY ASSURANCE

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

- B. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. 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 are similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329 and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- 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 installation 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:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

- d. When testing is complete, remove test specimens and test assemblies, do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Owner, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

## 1.8 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. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies as required when Work that requires testing or inspection will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. 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, Owner, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  1. Notify Architect, Owner, 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. **Associated Contractor 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. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  6. 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.
- 1.9 **SPECIAL TESTS AND INSPECTIONS**
- A. **Special Tests and Inspections:** Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

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.

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 014000

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

#### 1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer 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.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

#### 1.3 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. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. 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.
- E. 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.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

#### 1.5 PROJECT CONDITIONS

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

### PART 2 - PRODUCTS

#### 2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Coordinate location of interior field office or exterior trailer, at Owner's option, with Owner. Field office, if needed, shall be located within the work area.

#### 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. 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 Section 017419 "Construction Waste Management and Disposal" 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.
- 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.
  - 2. Shutdowns must be requested a minimum of (5) working days in advance of disruption.
- B. Sanitary Facilities: Use of owner's existing toilet facilities will be permitted, subject to coordination with any restrictions imposed by the Owner.
- C. 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.
- D. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
- E. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- F. 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.



### 3.4 SUPPORT FACILITIES INSTALLATION

- A. Parking: On-site parking areas for construction personnel is not available.
- B. Storage and Staging: Use designated areas of Project site for storage and staging needs. Storage and staging outside of the project area is the contractor's responsibility, including any associated permitting.
- C. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
  - 1. Identification Signs: Provide Project identification signs as indicated on Drawings or as requested by Owner.
  - 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.
- D. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- E. 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."
- F. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
- G. Existing Elevator Use: Coordinate with Owner for use of existing elevators.
- H. Existing Stair Usage: Coordinate with Owner for use of existing stairs.

### 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.
- C. 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.

- D. 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.
- E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- F. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- G. Temporary Partitions: Provide floor-to-ceiling dustproof partitions as necessary 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. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
  - 3. Provide walk-off mats at each entrance through temporary partition.
- H. 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 according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Controlled Construction Period: 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.

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. 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 015000

## SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

### PART 1 - GENERAL

#### 1.1 STIPULATIONS

- A. The specifications sections “General Conditions of Contract”, “Special Conditions” and “Division 1 General Requirements” form a part of this section by reference thereto and shall have the same force and effect as if printed herewith in full.

#### 1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Sections:
  - 1. Division 01 Section "Field Engineering" for field engineering and surveying.
  - 2. Division 02 Section "Selective Demolition" for partial demolition of buildings or structures.
  - 3. Division 31 Section "Site Clearing and Erosion Control".

#### 1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at 6 inches above the ground for trees up to, and including, 6-inch size; and breast height (DBH) for trees larger than 6-inch size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of the following:
  - 1. Organic Mulch: One (1) gallon of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
  - 2. Protection-Zone Fencing: Manufacturer’s cut sheets
  - 3. Protection-Zone Signage: Manufacturer’s cut sheets.
- C. Arborist Report: Written report prepared by Certified Arborist for care and protection of trees affected by construction during and after completing the Work.
  - 1. Report shall be submitted prior to any removals on site and shall include but is not limited to: recommendations for soil amendments at existing trees to remain, watering (volume)

during all work (at no additional cost to Owner), any required treatment for pests or disease, decompaction procedures within critical root zones, and any required root pruning. Soil amendment recommendations shall be coordinated with work of Section 329113 and shall include list of products, timing, and methodology.

2. Report shall include Tree Pruning Schedule with dates for such work. The written pruning schedule shall detail scope and extent of pruning for all trees to remain that interfere with or are affected by construction. Report shall include:
    - a. Species and size of tree.
    - b. Location on site plan. Include unique number identifier for each as shown in Contract Documents.
    - c. Reason for pruning.
    - d. Description of pruning to be performed.
    - e. Timing of pruning to be performed.
    - f. Description of maintenance by tree service firm following pruning.
- D. Qualification Data: For qualified arborist and tree service firm.
- E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
1. Use sufficiently detailed photographs or videotape.
  2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

## 1.5 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA.
1. Responsibilities include:
    - a. Preparation of report described above
    - b. Endorsement of report, prepared by GC, listing conditions detrimental to tree and plant protection
    - c. Oversight of tree protection installation and maintenance of protection measures including inspection reports
    - d. Pre-approval of temporary access within the critical root zone protection areas for activities such as hand removal of pavers
    - e. Oversight of root pruning, crown pruning, maintenance pruning, regrading;
    - f. Direct repair scope for damaged trees
    - g. Certification that trees indicated to remain have been protected during construction and were promptly/properly treated and repaired when damaged.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
    - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
    - b. Enforcing requirements for protection zones.
    - c. Arborist's responsibilities.
    - d. Field quality control.
    - e. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
    - f. Coordination of Work and equipment movement with the locations of protection zones.
    - g. Trenching by hand or with air spade within protected zones.

## 1.6 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.
- D. Protection fencing must be approved by the Owner's Representative prior to commencing with any demolition or construction work.
- E. Install protection fencing before installing erosion and sedimentation controls. Trenched silt fence is prohibited within plant protection zones. Utilize tubular sediment control device, such as Filtrexx® Sediment Control or similar product in accordance with the manufacturers instructions, in lieu of silt fencing. Trenching is prohibited within plant protection zones.
- F. Flows of water redirected from construction areas or generated by construction activity are prohibited from entering or crossing plant protection zones. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- G. Work within the plant protection zone must be approved by and supervised by Owner's Representative.
- H. The Owner's Representative may require additional protection fencing or relocation of fencing as work progresses.

- I. Bring any unforeseen site conditions, such as structural roots, that will impact new construction to the attention of the Owner's Representative. Do not proceed with work without written authorization.
- J. Arborist may require crown pruning to compensate for root loss caused by damaging or cutting of the root system. Provide subsequent maintenance during contract period as recommended by arborist.
- K. Campus care manager or his representative should be present when any work is done to or around campus plantings.

## PART 2 - GENERAL

### 2.1 MATERIALS

- A. Topsoil: Refer to 32 91 00 'Soil Preparation'.
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
  - 1. Type: Shredded hardwood.
  - 2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
  - 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.
  - 1. Safety Fence: 4' high plastic orange safety fence; 6' tall steel posts with tie wires, and other accessories for a complete fence system.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
  - 1. Size and Text: TREE PROTECTION AREA – DO NOT ENTER
  - 2. Lettering: 3-inch high minimum, white characters on red background.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

### 3.2 PREPARATION

- A. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

### 3.3 TREE- AND PLANT-PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
  - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
  - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

### 3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving."
- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate and/or air-spade under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.



### 3.5 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
  - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
  - 2. Cut Ends: Do not coat cut ends of roots with an emulsified asphalt or similar coatings.
  - 3. Temporarily support and protect roots from damage until they are covered with soil.
  - 4. Cover exposed roots with burlap and water regularly.
  - 5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune roots 6 inches inside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

### 3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
  - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
  - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
    - a. Type of Pruning: Cleaning, Thinning, and/or Reduction.
    - b. Specialty Pruning: Restoration.
  - 3. Cut branches with sharp pruning instruments; do not break or chop.
  - 4. Do not apply pruning paint to wounds
- B. Chip removed branches and dispose of off-site.

### 3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
  - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

### 3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

### 3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
  - 1. Submit details of proposed root cutting and tree and shrub repairs.
  - 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
  - 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
  - 4. Perform repairs within 24 hours.
  - 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.
  - 1. Provide new trees of same size and species as those being replaced for each tree that measures 6 inches or smaller in caliper size.
  - 2. Provide two new trees of 4-inch caliper size for each tree being replaced that measure between 6-inch caliper and 8-inch caliper in size at a location directed by the Owner or Owner's Representative.
  - 3. Provide 6-inch caliper size for each tree being replaced that measure greater than 8-inch caliper in size at a location directed by the Owner or Owner's Representative. Quantity of trees shall equal the total diameter at breast height (DBH) size of the tree removed unless directed otherwise by the Owner. For example, a 32-inch DBH shall require five new trees.
  - 4. Species: Species selected by Landscape Architect.
  - 5. Plant and maintain new trees as specified in Section 32 93 00 'Plants'.
- C. Soil Aeration: Where directed by Landscape Architect, aerate surface soil compacted during construction. Aerate to extent as directed by Landscape Architect beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with approved Compost.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

#### 1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. 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.
- C. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by the Contractor.

#### 1.3 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.

#### 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.5 PRODUCT WARRANTIES

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

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

1.6 ACTION SUBMITTALS

- A. Substitution Request: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to 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 substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    - j. Cost information, including a proposal of change, if any, in the Contract Sum.
    - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
  2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or 14 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

## 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.
- 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, but are not guaranteed to be approved, 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, which 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: ..."

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, which 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: ..."
  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 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 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- ## 2.2 COMPARABLE PRODUCTS
- A. Conditions for Consideration 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 these 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 named in the Specifications. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Coordination of Owner-installed products.
  - 6. Progress cleaning.
  - 7. Starting and adjusting.
  - 8. Protection of installed construction.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for limits on use of Project site.
  - 2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
  - 3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

#### 1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

#### 1.3 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.
- C. 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of utilities and construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of utilities, mechanical and electrical systems, and other construction affecting the Work.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings. If discrepancies are discovered, notify Architect promptly.
- B. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

### 3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
  - G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
  - H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
    - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
    - 2. Allow for building movement, including thermal expansion and contraction.
    - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
  - I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
  - J. Remove and replace damaged, defective, or non-conforming Work.
- 3.5 CUTTING AND PATCHING
- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
    - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
  - B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
  - C. Temporary Support: Provide temporary support of work to be cut.
  - D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
  - E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
  - F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  5. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.6 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300



## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

#### 1.2 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.

#### 1.3 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.

3. Total quantity of waste in tons (tonnes).
  4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
  5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
  6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
  7. Total quantity of waste recovered (salvaged 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. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. 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.
- F. 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.
- 1.5 QUALITY ASSURANCE
- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination."
- 1.6 WASTE MANAGEMENT PLAN
- A. 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.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. 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.

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 50 percent by weight of total nonhazardous solid waste generated by the Work. Facilitate recycling and salvage of materials to divert materials from landfill.

## 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.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
  1. Distribute waste management plan to everyone concerned.
  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.
- C. 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.

### 3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.

B. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale Not permitted on Project site.

D. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND 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.

### 3.4 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
  1. Pulverize concrete as required to recycle.
- B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
  1. Pulverize masonry as required to recycle.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. 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.
- E. 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.
- F. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- G. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- H. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- I. Conduit: Reduce conduit to straight lengths and store by material and size.
- J. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

### 3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
  1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. 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.

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.

D. Paint: Seal containers and store by type.

3.6 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.

END OF SECTION 017419

## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  - 5. Repair of the Work.
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 3. Perform closeout procedure required by Owner's standards. Owner standards and contract will govern if in conflict with this section.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

#### 1.4 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 14 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.
  5. Submit testing, adjusting, and balancing records.
  6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 14 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.
  6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  7. Complete final cleaning requirements.
  8. 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 14 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.



## 1.5 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.
  - 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.
- 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.

## 1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
  - 2. Organize items applying to the space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  - 3. Submit list of incomplete items electronically.

## 1.7 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. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. 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.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## 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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. 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.
    - c. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
    - e. Vacuum and mop concrete.
    - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    - g. 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.
    - h. Remove labels that are not permanent.
    - i. Wipe surfaces of mechanical, electrical, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - j. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

- k. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - l. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - m. 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, before requesting inspection for determination of Substantial Completion.
  - B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 017700

## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation 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. Owner Standards: Requirements of this section shall not be taken to override or invalidate Owner standards for operations and maintenance data. Submitted manuals shall comply with all applicable Owner standards and requirements.

#### 1.2 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 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 Architect. Enable reviewer comments on draft submittals.
- C. Final Manual Submittal: Submit final manuals in format acceptable to the Owner.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

#### 1.3 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 if requested by the Owner.
- 1.4 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.
- 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."

## 1.5 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. 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.
- D. 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.

## 1.6 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.
- 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.

1.7 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.
- 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. 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.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.



G. 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.

H. 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.

## 1.8 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. 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.

D. 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.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. 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 017823

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Product Data.
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 2. Submit Record Documents as required by the Owner standards and contract for construction. Owner standards and contract will govern if in conflict with this section.

#### 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one full set of marked-up record prints.
- B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

#### 1.3 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. Revisions to routing of piping and conduits.
  - d. Revisions to electrical circuitry.
  - e. Actual equipment locations.
  - f. Duct size and routing.
  - g. Locations of concealed internal utilities.
  - h. Changes made by Change Order or Construction Change Directive.
  - i. Changes made following Architect's written orders.
  - j. Details not on the original Contract Drawings.
  - k. Field records for variable and concealed conditions.
  - l. 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 sets 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.

#### 1.4 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.

- C. Format: Submit record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.
  - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.5 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

PART 3 - EXECUTION

END OF SECTION 017839

## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.

#### 1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition 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.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.
- C. Schedule of selective demolition activities with starting and ending dates for each activity.
- D. Predemolition photographs or video.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

#### 1.5 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

## 1.6 FIELD CONDITIONS

- A. Condition of Structures: City assumes no responsibility for actual condition of items or structures to be demolished.
  - 1. City will maintain conditions existing at time of inspection for bidding purposes insofar as practical. Minor variation within structure may occur by City's removal and salvage operations prior to start of selective demolition.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: Hazardous materials may be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.
- F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## 1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties, if any.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure during selective building demolition operations. Notify structural engineer of record of any deficiencies discovered during demolition.
- C. Inventory and record the condition of items to be removed and salvaged.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.



### 3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  4. Maintain fire watch during and after flame-cutting operations.
  5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  6. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area designated by Owner.
  5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition, cleaned, and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 CLEANING

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

## SECTION 03 30 53 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Walls.
  - 2. Footings.
  - 3. Slabs-on-grade.

#### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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. Reinforcing splices shall be lapped in accordance with ACI minimums. Make bars continuous around corners. Laps shall, in no case, be less than 48 bar diameters.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
  - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- 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. Bonding agents.
7. Adhesives.
8. Joint-filler strips.
9. Repair materials.

- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- 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.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- 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. 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.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: The Contractor shall engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1 or better.
    - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    - c. Structural 1, B-B or better; mill oiled and edge sealed.
    - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will 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.

### 2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed. Reinforcing steel shall be detailed according to the ACI Manual of Standard Practice (ACI 315), latest edition.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, ASTM A 767/A 767M, Class I zinc coated after fabrication and bending.
- E. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.
- F. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.
- G. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets. WWR shall conform to ASTM A185, with a minimum ultimate tensile strength of 70,000 psi.

### 2.3 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. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
- C. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.
- D. 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 supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
  - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

### 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type II gray.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
  
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride. Concrete Admixtures containing calcium chloride or other chloride salts shall not be used, except when water soluble chloride ion content is limited to 0.30 percent by weight of cement.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
  
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
  - 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. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
    - b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
    - c. Grace Construction Products, W. R. Grace & Co.; DCI.
    - d. Sika Corporation; Sika CNI.
    - e. Or approved equal.

- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
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; Rheocrete 222+.
    - b. Grace Construction Products, W. R. Grace & Co.; DCI-S.
    - c. Sika Corporation; FerroGard 901.
    - d. Or approved equal.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
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. ChemMasters.
    - b. Davis Colors.
    - c. Dayton Superior Corporation.
    - d. Hoover Color Corporation.
    - e. Lambert Corporation.
    - f. QC Construction Products.
    - g. Rockwood Pigments NA, Inc.
    - h. Scofield, L. M. Company.
    - i. Solomon Colors, Inc.
    - j. Or approved equal.
  2. Color: As selected by Architect from manufacturer's full range.
- F. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- G. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.



2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
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. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    - b. BASF Construction Chemicals - Building Systems; Confilm.
    - c. ChemMasters; SprayFilm.
    - d. Conspec by Dayton Superior; Aquafilm.
    - e. Dayton Superior Corporation; Sure Film (J-74).
    - f. Edoco by Dayton Superior; BurkeFilm.
    - g. Euclid Chemical Company (The), an RPM company; Eucobar.
    - h. Kaufman Products, Inc.; Vapor-Aid.
    - i. Lambert Corporation; LAMBCO Skin.
    - j. L&M Construction Chemicals, Inc.; E-CON.
    - k. Meadows, W. R., Inc.; EVAPRE.
    - l. Metalcrete Industries; Waterhold.
    - m. Nox-Crete Products Group; MONOFILM.
    - n. Sika Corporation; SikaFilm.
    - o. SpecChem, LLC; Spec Film.
    - p. Symons by Dayton Superior; Finishing Aid.
    - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
    - r. Unitex; PRO-FILM.
    - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
    - t. Or approved equal.
- 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, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
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. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    - b. BASF Construction Chemicals - Building Systems; Kure 200.
    - c. ChemMasters; Safe-Cure Clear.
    - d. Conspec by Dayton Superior; W.B. Resin Cure.
    - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    - f. Edoco by Dayton Superior; Res X Cure WB.
    - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    - h. Kaufman Products, Inc.; Thinfilm 420.
    - i. Lambert Corporation; AQUA KURE - CLEAR.
    - j. L&M Construction Chemicals, Inc.; L&M Cure R.
    - k. Meadows, W. R., Inc.; 1100-CLEAR.
    - l. Nox-Crete Products Group; Resin Cure E.
    - m. Right Pointe; Clear Water Resin.
    - n. SpecChem, LLC; Spec Rez Clear.
    - o. Symons by Dayton Superior; Resi-Chem Clear.
    - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
    - q. Vexcon Chemicals, Inc.; Certi-Vex Enviochure 100.
    - r. Or approved equal.
- F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
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; Kure-N-Seal 25 LV.
    - b. ChemMasters; Spray-Cure & Seal Plus.
    - c. Conspec by Dayton Superior; Sealcure 1315.
    - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
    - e. Edoco by Dayton Superior; Cureseal 1315.
    - f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
    - g. Kaufman Products, Inc.; Sure Cure 25.
    - h. Lambert Corporation; UV Super Seal.
    - i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
    - j. Meadows, W. R., Inc.; CS-309/30.
    - k. Metalcrete Industries; Seal N Kure 30.
    - l. Right Pointe; Right Sheen 30.
    - m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.
    - n. Or approved equal.
  2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.7 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, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  - 1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. 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.
- E. 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.

## 2.8 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, 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, 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.

## 2.9 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. Ground Granulated Blast-Furnace Slag: 50 percent.
  - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  - 5. Silica Fume: 10 percent.
  - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 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 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 for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

## 2.10 CONCRETE MIXTURES FOR SITE ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 3500 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
  - 3. Slump Limit: 5 inches (125 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
  - 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size. Conform to ASTM C260.
  - 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size. Conform to ASTM C260.

- B. Slabs-on-Grade, Pavement at Sprayground, Curbs and Edge Restraints: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
  3. Slump Limit: 4 inches, plus or minus 1 inch (25 mm).
  4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
  5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
  6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

## 2.11 FABRICATING REINFORCEMENT

- A. See 1.4 ACTION SUBMITTALS of this document for Shop Drawings.

## 2.12 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. The Contractor shall notify the Project Administrator of any concrete delivery on site at least 24 hours in advance.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads. All material used for formwork shall be new.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated on drawings, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate 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.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- 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 as indicated on the Drawings.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is 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's "Code of Standard Practice for Steel Buildings and Bridges."
  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 sides of beams, 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 degrees F (10 degrees C) for 48 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.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be 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 Architect.

### 3.4 CONCRETE FOUNDATIONS

- A. Foundations shall bear on undisturbed soil having minimum bearing capacity of 2500 psf. Adjust bottom of footing elevations as required to bear on uniformly dense inorganic subgrade.
- B. All exterior footings shall be placed a minimum of 3'-0" below final grade.
- C. Footings shall be placed such that the line drawn between the lower edges of adjoining footings shall not have a slope steeper than 30 deg from the horizontal. Footings shall be stepped at a rate of 2 horizontal feet to one vertical foot.
- D. Excavations for any purpose shall not remove lateral support from any footing or foundation without protecting the footing or foundation against settlement or lateral translation.
- E. Excavations shall have a maximum allowable slope from the horizontal of 1:1 for cohesive soils, and 1.5:1 for granular soils. Additionally, excavations shall meet OSHA requirements for sloping and benching.
- F. Slabs on grade shall bear on soil compacted to 95% dry density per ASTM D1557. Slabs have been designed using a modulus of subgrade reaction of 100 psi/inch. Provide PADot 2A well graded crushed stone as a sub-base when existing soil has been disturbed.
- G. The slab base course shall consist of at least 6" of AASHTO no. 57 compacted crushed stone.

### 3.5 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.6 VAPOR RETARDERS

- 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. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
  - 1. Place and compact a 1/2-inch thick layer of fine-graded granular material over granular fill.

### 3.7 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would 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.
- 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. Welded wire reinforcing shall be supplied in sheets. Lap two full mesh lengths at splices and wire together. 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.
- F. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.
- G. The following minimum concrete cover shall be provided for reinforcement:  
Concrete cast against the earth: 3"  
Concrete exposed to earth or weather: 1-1/2" (#5 bar or smaller), 2" (#6 bar or larger)  
Interior concrete slabs, top surface: 3/4"
- H. Provide rebar lap lengths as follows:

# 4 rebar	24"
# 5 rebar	30"
# 6 rebar	36"

### 3.8 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.



- B. Control Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-third 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.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed and locations approved by Architect.
- 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 concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for sidewalks and 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 bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. 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.

G. Hot-Weather Placement: Comply with ACI 301 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.

### 3.10 ADDITIONAL CONCRETE ITEMS

- A. When concrete is placed at or below a temperature of 40°F or when this temperature is likely to occur within 24 hours of placement, protect in accordance with ACI 306, "Recommended Practice for Cold Weather Concreting". Do not place concrete in water or on snow, ice or frozen or water softened ground.
- B. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305, "Recommended Practice for Hot Weather Concreting".
- C. Immediately after placement, protect concrete from premature drying. Preserve moisture in concrete for at least 3 days after placement by either: continuous sprinkling, application of wet mats, or application of an approved curing compound.
- D. Conduits, pipes and sleeves shall not be larger in diameter than 1/3 thickness of the concrete in which they are embedded, UNO. Minimum concrete between sleeves shall be (3) sleeve diameters.
- E. When installing expansion bolts or adhesive anchors, the contractor shall take measures to avoid drilling or cutting of any existing reinforcing and destruction of concrete. Installer shall be trained by Manufacturer on installation procedures. Clean hole free of dust, debris, and moisture. Use compressed air and wire brush, in accordance with manufacturers procedures. Verify that adhesives to be used, are within expiration date. Provide Hilti or approved alternative.
- F. Chamfer all exposed concrete corners, unless noted otherwise on architectural drawings.
- G. Provide crack control joints (of depth = 1/4 the slab thickness) for slabs on grade at 15 feet o.c. maximum spacing. At unexposed slabs, joints shall be saw-cut within the first 12 hours of concrete placement. At exposed slabs, joints shall be formed.
- H. Concrete footings shall be anchored to existing intersecting foundations, by drilling and grouting in place, at least (2) #4 footing rebar with 6" embedment into existing foundations.
- I. Any stop in concrete work must be made with vertical bulkheads and horizontal keys, unless otherwise shown. All reinforcing is to be continuous through joints.

### 3.11 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Broom Finish: Apply a broom finish to exterior concrete pavement, 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.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- 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 and Edge Restraints: Light-brown finish.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- 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, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

### 3.14 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 one month. 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 joint 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.

3.15 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 and Owner's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half 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 work 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 will match 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 for 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 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.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. 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 walls and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain 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. 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.
  3. Air Content: ASTM C 231, 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.
  4. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
  5. 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.
  6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  7. 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.
  8. 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.
  9. 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.
  10. 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 agency 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.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03 30 53

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## 034550 – SITE PRECAST ARCHITECTURAL 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. This Section includes the following:
  - 1. Architectural precast concrete capstone for brick walls
- B. Related Sections include the following:
  - 1. Section 033000 Cast-in-Place Concrete
  - 2. Division 7 Section Joint Sealants
  - 3. Section 321500 Site Masonry

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
  - 1. Dead Loads: uniform load of 150 lb/ft.
  - 2. Live Loads: uniform load of 50 lb/ft applied in any direction and concentrated load of 200 lb/ft applied in any direction. Uniform and concentrated loads need not be assumed to act concurrently.
  - 3. Assume live and dead loads are concurrent.
  - 4. Design precast concrete units and connections to maintain clearances at openings, to all for fabrication and construction tolerances.

#### 1.4 REFERENCES

- A. The following apply to work in this Section:
  - 1. ACI: American Concrete Institute
  - 2. PCI: Precast/Prestressed Concrete Institute

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Cementitious materials. Include brand, type, and name of manufacturer.

2. Setting bed mortar mixes. Include description of type and proportions of components.
  3. Joint sealants and backer rods.
  4. Anchors, clips, dowels, pins and other metal accessories.
- B. Precast Mix Designs: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- 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 C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
- E. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at corners.
1. Indicate separate face and backup mixture locations and thicknesses.
  2. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to substrate or other construction.
  3. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
  4. Include plans and elevations showing unit locations and sequence of installation for special conditions.
  5. Indicate relationship of architectural precast concrete units to adjacent materials.
  6. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the design concept.
- F. Precast Samples: For each finish indicated on exposed surfaces of architectural precast concrete units illustrating full range of finish, color, and texture variations expected; approximately 4 by 4 by 1 inches.
1. When other faces of precast concrete unit are exposed, include samples illustrating workmanship, color, and texture of all faces of concrete.
  2. Several color and finish samples may be required prior to final selection by

Owner.

- E. Sealant Samples for Color Selection: Color charts consisting of actual sections of sealant showing manufacturer's full range of colors. Selected product may be a standard color or a custom blended color.
- G. Qualification Data: For fabricator and Testing Agency.
- H. Material Certificates: For the following items, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Reinforcing materials.
  - 3. Admixtures.
  - 4. Anchors.
- I. Material Test Reports: For aggregates.
- J. Source quality-control test reports.
- K. Field quality-control test and special inspection reports.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Testing Agency Qualifications: An independent testing agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- D. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
- B. Support units during shipment on nonstaining shock-absorbing material.
- C. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.

- E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
- F. Lift and support units only at designated points shown on Shop Drawings.

## 1.8 SEQUENCING

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

## PART 2 - PRODUCTS

### 2.1 PRECAST ARCHITECTURAL CONCRETE

- A. Custom engineered and fabricated, reinforced precast concrete, smooth finish, no visible aggregate, in sizes and shapes as indicated on Drawings.
- B. Manufactured by Sun Precast Co., Inc., 4051 Ridge Road, Beaver Springs, PA 17812, 570-658-8000 or approved equal.
- C. Precast Concrete Capstone: high performance structural wet cast mix with epoxy-coated reinforcing.
  - 1. Basis of design color: TBD, acid-etch finish. Color and finish to be finalized during sample submittal and approval process.

### 2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
  - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

### 2.3 REINFORCING MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] percent.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars ASTM A775/A775M epoxy coated.
- C. Glass polymer fiber reinforcing.

- D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

## 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
  - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source if required to meet color requirements.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry).
  - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
    - a. Size:  $\frac{3}{4}$ " or as determined in mix design development.
  - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- C. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11 percent.
- D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
  - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
  - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

## 2.5 STAINLESS-STEEL ANCHORS AND CONNECTION MATERIALS

- A. Stainless steel Type 304.

## 2.6 ACCESSORIES

- A. Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

## 2.7 SEALANT MATERIALS

- A. Non-staining silicone joint sealants and backing rods in accordance with Specification Section 079200.

## 2.8 MORTAR AND GROUT

- A. Mortar and Grout: comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout if they have reached their initial set before being used. Subject to compliance with requirements, available products that may be incorporated into the Work include the following, or approved comparable products:
  1. Portland Cement: ASTM C150, Type I or Type II
  2. Hydrated Lime: ASTM C207, Type S
  3. Sand: ASTM C144
  4. Latex Additive: Manufacturer's standard, acrylic-resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.
  5. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated
  6. Grout: provide pigmented grout as reviewed and approved by Architect. Proportion and mix grout ingredients according to grout manufacturer's written instructions.
- B. Mortar bed bond coat: mix neat cement and water to creamy consistency.
- C. Mortar for setting: Type S.

## 2.9 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- C. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or

field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
  2. Maximum Water-Cementitious Materials Ratio: 0.45.
- D. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- E. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).
  2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft. (1842 kg/cu. m), plus or minus 3 lb/cu. ft. (48 kg/cu. m), according to ASTM C 567.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## 2.10 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement by release agent.
1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
1. Form joints are not permitted on faces exposed to view in the finished work.

## 2.11 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units

as required for performance of the Work.

- D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
  - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
  - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
  - 3. Place reinforcing steel to maintain at least 3/4-inch (19-mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
- F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- I. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- K. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a



surface that will not show in finished structure.

- M. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- N. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

## 2.12 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product and position tolerances.
- B. Product tolerances:
  - 1. Overall Height and Width of Units, Measured at the Face Exposed to View: 10 feet or under, plus or minus 1/8 inch.
  - 2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: 10 feet or under, plus or minus 1/4 inch.
  - 3. Total Thickness or Flange Thickness: Plus 1/4 inch, minus 1/8 inch.
  - 4. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches total.
  - 5. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch.
  - 6. Location and Dimension of Block-outs Hidden from View and Used for Utility Penetrations: Plus or minus 3/4 inch.
  - 7. Bowing: Plus or minus L/360, maximum 1/2 inch.
  - 8. Local Smoothness: 1/4 inch per 10 feet.
  - 9. Warping: 1/16 inch per 12 inches of distance from nearest adjacent corner.
  - 10. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch.
- C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
  - 1. Inserts: Plus or minus 1/2 inch.
  - 2. Handling Devices: Plus or minus 3 inches.
  - 3. Reinforcing Steel: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.

4. Location of Rustication Joints: Plus or minus 1/8 inch.
5. Location of Openings: Plus or minus 1/8 inch.
6. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch maximum over the full dimension of unit.
7. Position of Sleeve: Plus or minus 1/2 inch.

## 2.13 FINISHES

- A. Faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved samples and mockups and as follows:
  1. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
- B. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.

## 2.14 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.
- C. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
  1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  2. Cores will be tested in an air-dry condition.
  3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
  4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
    - a. Project identification name and number.
    - b. Date when tests were performed.
    - c. Name of precast concrete fabricator.

- d. Name of concrete testing agency.
  - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting foundations and conditions for compliance with requirements for installation tolerances, true and even bearing surfaces, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting cast-in-place concrete structure has attained minimum allowable design compressive strength.

### 3.2 INSTALLATION

- A. Install clips, hangers and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
  - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
  - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
  - 4. Unless otherwise indicated, maintain uniform joint widths of 3/8 inch.
- C. Set precast concrete units to comply with requirements indicated on Drawings. Install supports, fasteners, attachments and setting beds to secure units in place. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

### 3.3 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

### 3.4 REPAIRS

- A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 10 feet.
- C. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

### 3.5 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034550

## SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

#### 1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
  - 1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

### PART 2 - PRODUCTS

#### 2.1 HYDRAULIC CEMENT UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ARDEX Americas.
    - b. BASF Corporation; Construction Systems.
    - c. L&M Construction Chemicals, Inc.
    - d. LATICRETE SUPERCAP, LLC.
    - e. MAPEI Corporation.
  - 2. Cement Binder: ASTM C 150/C 150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.

3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.
  4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- E. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
  2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
- C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

#### 3.2 APPLICATION

- A. General: Mix and apply components according to manufacturer's written instructions.
1. Close areas to traffic during application and for time period after application recommended in writing by manufacturer.
  2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
  3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment or concrete topping to produce uniform, level surface.
  - 1. Apply a final layer without aggregate to product surface.
  - 2. Feather edges to match adjacent floor elevations.
  - 3. Finish to slope as indicated on drawings, or to match existing conditions where not indicated.
- D. Cure according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Apply surface sealer at rate recommended by manufacturer.
- G. Remove and replace areas of product application that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

END OF SECTION 035416

## SECTION 042000 - UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes masonry materials intended for use as infill to match existing conditions and for new interior partitions:
  - 1. Concrete masonry units.
  - 2. Brick.
  - 3. Mortar and grout materials.
  - 4. Ties and anchors.
  - 5. Embedded flashing.
  - 6. Accessories.
  - 7. Mortar and grout mixes.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type and color of exposed masonry unit and mortar.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product and for masonry units, include data on material properties.
- 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.
  - 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

#### 1.4 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.



## PART 2 - PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, 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.

### 2.2 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 if required to match existing conditions.
- B. CMUs: ASTM C90, normal weight, unless otherwise indicated.

### 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.
  - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C216 and matching existing for color, texture, and pattern.
  - 1. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
  - 2. Size (Actual Dimensions): Match existing.

### 2.4 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.
  - 1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- 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. Color, Texture, and Joint Pattern: Match existing.
- 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. For joints less than 1/4 inch (6.4 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
  - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
- F. Water: Potable.

## 2.5 CONCRETE AND MASONRY LINTELS

- A. General: For exposed conditions, provide masonry lintels complying with requirements below. For concealed conditions, provide either concrete or masonry lintels, at Contractor's option, complying with requirements below.
- B. Concrete Lintels: Precast units made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars indicated or required to support loads indicated. Cure precast lintels by same method used for concrete masonry units.
- C. Masonry Lintels: Built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

## 2.6 REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Single Wythe Joint Reinforcement: ASTM A951; Truss type; steel; 0.188 inch diameter side rods and 0.148 inch diameter cross ties; hot dip galvanized.
  - 1. Hohmann & Barnard Inc.; Lox-All 120 Truss-Mesh
  - 2. Wire-Bond; Truss Type Series 300.

## 2.7 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) 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.
  - 2. Stainless Steel Wire: ASTM A580/A580M, Type 304.

3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Tie and Anchor Type: As indicated or required to match existing conditions.

## 2.8 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated.
- B. 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 masonry 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. 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 exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  3. For interior nonload-bearing partitions, Type O may be used instead of Type N.

## 2.10 FLASHINGS

- A. Thru Wall: Stainless steel; ASTM A240/A240M, Type 304, soft temper;.015 inch thick; smooth finish.

2.11

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. 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.
- B. 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.

### 3.2 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 (13 mm) or minus 1/4 inch (6.4 mm).
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) 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. (6.4 mm in 3 m), or 1/2-inch (13-mm) 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. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) 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. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.

#### C. Joints:

- 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm), with a maximum thickness limited to 1/2 inch (13 mm).
- 2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6.4 mm).

3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3.2 mm).

### 3.3 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 Infill Exposed Masonry: Match existing.
- C. Bond Pattern for New Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Fill cores in hollow CMUs with grout 24 inches (610 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay CMU 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.
  5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.5 CAVITY WALLS

- A. Bond wythes of cavity walls together as follows:
  1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 36 inches

(914 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (914 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Installing Cavity Wall Insulation: Match existing, if any.

### 3.6 LINTELS

A. Install loose steel lintels or bond beams over openings.

B. Maintain minimum 8 inches bearing on both sides of opening.

### 3.7 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
3. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### 3.8 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (457 mm) of finished grade.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 04 43 00 – SITE STONE 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 SECTION INCLUDES

- A. Stone Boulder.

1.3 RELATED REQUIREMENTS

- A. Division 01 Section “Construction Waste Management”.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials:
  - 1. ASTM A666 - Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.

1.5 PERFORMANCE REQUIREMENTS

- A. American Society for Testing and Materials:
  - 1. Design anchor attachment to stone with a factor of safety of 5:1

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated including, but not limited to:
  - 1. Joint sealants and backer rods.
  - 2. Anchors, clips, dowels, pins and other metal accessories.
  - 3. Shims and setting buttons; plastic or nylon.
  - 4. Mortar for stairs and coping.
- B. Samples for Initial Selection
  - 1. Boulder:
    - a. Submit photos with dimensions of proposed boulders. Landscape Architect may review boulders in person at the quarry.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.
- B. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from one quarry with resources to provide materials of consistent quality in appearance and physical properties.
- C. 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.

## 1.8 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 designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.9 PROJECT CONDITIONS

- A. Protection of Stone Masonry: Cover partially completed stone masonry when construction is not in progress to protect from inclement weather.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the exposed surfaces of stone masonry.
  - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.
  - 2. Protect all exposed surfaces from mortar droppings, including adjacent constructions such as concrete pavement or any other adjacent surface.
- 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 stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days



after completing cleaning. Protect all exposed surfaces from mortar droppings, including adjacent constructions such as concrete pavement or any other adjacent surface.

- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 60

#### 1.10 COORDINATION

- A. Advise installers of other work about specific requirements for placement of reinforcement, veneer anchors, and similar items to be built into stone masonry.
- B. Verify field measurements prior to fabrication. Notify Landscape Architect of any discrepancies prior to fabrication.

### PART 2 - PRODUCTS

#### 2.1 BLUESTONE

- A. Defective Material: Referenced standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. From Johnson Quarries, 15962 Rt. 467, Stevensville, PA, 18845, (570) 744-1284, [www.johnsonquarries.com](http://www.johnsonquarries.com).
- C. Grade A sound bluestone, free from laminations and open reeds. Size as shown on Drawings.

#### 2.2 BOULDER

- A. Mixture of Quarry Saw Blocks for seating, and Bluestone Boulders or Fieldstone Boulders for retaining and seating. Irregular shape, various sizes, max. 3'l x 2'2 x 2'h, min. 2'l x 18"w x 18" h. Can be obtained from Johnson Quarries, or locally sourced. Color range to include gray and tan.

#### 2.3 SETTING BED AND JOINT MATERIALS

- A. Refer to Section 321400 Unit Paving for all setting bed and joint material information.

#### 2.4 MORTAR MATERIALS, MIXES, AND GROUT

- A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, 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.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate for Mortar: ASTM C 144.

1. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Mortar Pigments: Natural and synthetic iron oxides. Use pigments with a record of satisfactory performance in mortar. Pigments shall contain no carbon black.
- F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

## 2.5 MORTAR MIXES

- A. General: Do not add mixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds, or calcium chloride, unless otherwise indicated or previously approved by Landscape Architect.
- 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 C 270, Proportion Specification. Provide Type N for wall veneer and coping.
- D. Water: Potable, clean and free from deleterious acids, alkalies, and organic matter.
- E. Mixing: Combine and thoroughly mix pre-blended dry materials to water in a mechanical batch mixer; comply with ASTM C270 proportion specification and manufacturer's instructions for mixing time and water content, unless otherwise indicated.

## 2.6 ANCHORS AND FASTENERS

- A. Anchor Material: Stainless steel, ASTM A 666, Type 304
- B. Dowels and Pins Material: Stainless steel, ASTM A 276, Type 304

## 2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Backer Rod for Sealant Joints: Flexible, closed cell, non-gassing, polyethylene, rope-like joint backing material of appropriate diameter for specified joint size as indicated on the Drawings to resist pressure during sealant tooling. Backer rod shall not stain or adhere to sealant materials and shall be fully compatible with sealant compounds.
- B. Sealant for Joints: In compliance with manufacturers instructions, provide Sonneborn Sonolastic NP 2, or approved comparable product. Landscape Architect shall select color from the full range of standard colors.
- C. Setting Shims: Plastic or vulcanized neoprene.
- D. Setting Buttons: Resilient plastic buttons.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected

### 3.2 PREPARATION

- A. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

### 3.3 SETTING OF STONE MASONRY, GENERAL

- A. Perform necessary field cutting and trimming as stone is set. Do not trim exposed ends or faces. Cuts shall be made a joints or hidden surfaces
  - 1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping
- B. Sort stone before it is placed to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones as indicated on Drawings.
- D. Set stone to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- E. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Set walls with joints not less than 1/4 inch at narrowest points or more than 1/2 inch at widest points.
- F. Provide sealant joints of widths and at locations indicated.
  - 1. Keep sealant joints free of mortar and other rigid materials.
- G. Place weep holes in joints where moisture may accumulate.
  - 1. Use specified product herein to form weep holes.
  - 2. Space weep holes as indicated on Drawings.

### 3.4 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Mix and place only that amount of mortar bed that can be covered with pavers or steps before initial set. Before placing pavers or steps, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- C. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.
- D. Tamp or beat pavers or steps with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver or step in a single operation before initial set of mortar; do not return to areas already set or disturb pavers or steps for purposes of realigning finished surfaces or adjusting joints.
- E. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/16 inch.
- F. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

### 3.5 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet or more.
- B. Variation from Level: For joints and lines of coping, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or more.
- C. Measure variation from level, plumb, and position shown in plan as variation of the average plane of the face of each stone from level, plumb, or dimensioned plane.
- D. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.
- E. Variation in Plane between Adjacent Rough Stones: Do not exceed one-half of tolerance specified for thickness of stone.

### 3.6 INSTALLATION OF ANCHORED STONE MASONRY

- A. Set stone in full bed of mortar unless otherwise indicated. Build anchors into mortar joints as stone is set.
- B. Provide 1-inch minimum cavity between stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.
  - 1. Place mortar spots in cavity at veneer anchors to maintain spacing.
  - 2. Slope beds toward cavity to minimize mortar protrusions into cavity.
  - 3. Do not attempt to trowel or remove mortar fins protruding into cavity.

- C. Rake out joints for sealant to depth of not less than dimension indicated on Drawings before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

### 3.7 ERECTION TOLERANCES

- A. Variation in Line: Do not exceed 1/8 inch in 96 inches.
- B. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch or 1/4 inch of nominal joint width, whichever is less.
- C. Variation in Surface Plane: Do not exceed 1/8 inch in 10 feet maximum from level or slope  
Variation in Plane between Adjacent Units: Do not exceed 1/32-inch difference between planes of adjacent units.

### 3.8 JOINTING

- A. Prepare joint surfaces for sealant by removing mortar from joint before it sets and brush clean dust and mortar particles from joint prior to application of sealant.
- B. Tape-off stone-joint to protect the adjacent surface from contact with the sealant and to create a crisp line. Tool joints, with a smooth jointing tool to produce a concave joint profile set just below the face of stone.

### 3.9 ADJUSTING AND CLEANING

- A. Remove and replace stone masonry of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Landscape Architect.
  - 2. Defective joints.
  - 3. Stone masonry not matching approved samples and mockups.
  - 4. Stone masonry not complying with other requirements indicated.
- B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement
- C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears and sealant before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Landscape Architect's approval of sample cleaning before cleaning stone masonry
  - 3. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.

END OF SECTION 04 43 00

## 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. Anchor Rods
  - 3. Grout.
- B. Related Requirements:
  - 1. Section 053100 "Steel Decking"
  - 2. Section 055000 "Metal Fabrications"

#### 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 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 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. Welding certificates - Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Certificate for AISC certified fabricator, or source quality control reports
- F. Quality control field inspections reports.

#### 1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Standard Steel Building Structures (STD).
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Code Required Special Inspection and Testing:
1. Welding: One of the following.
    - a. Current American Welding Society (AWS) Certified Welding Inspector.
    - b. Current AWS Certified Welding Educator.
    - c. Current AWS Certified Welding Engineer or Current American Welding Society/American Institute of Steel Construction (AWS/AISC) Certified Steel Structure Inspector.
  2. Nondestructive Testing of Welds:
    - a. Current Nondestructive Testing Level II or III (Magnetic Particle Testing, Liquid Penetrate Testing, Ultrasonic Testing or Radiographic Testing)
      - 1) Level II personnel shall be qualified in accordance with the American Society of Nondestructive Testing (ASNT) document SNT-TC-IA (current edition). Level II certification as determined by a Level III examiner is required for each category.
      - 2) Level III Examiner shall be certified by ASNT unless all level II personnel have a current ASNT Central Certification Program certification. Only then will in-house designation of Level III nondestructive testing personnel be permitted.
  3. High Strength Bolting:
    - a. Current ICC Structural Steel and Welding certificate with one year of related experience or Current AWS/AISC Certified Steel Structure Inspector.

## 1.8 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. Deliver AESS to Project site in such quantities and at such times to ensure continuity of installation. All tie downs on loads shall be nylon straps or shall use softeners when using chains or wire rope slings to avoid damage to edges and surfaces of members. The standard for acceptance of delivered and erected members shall be equivalent to the standard employed at fabrication.
- C. Handle finish AESS pieces using nylon type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged. Conform to ANSI/AISC 303-16 Sections 10.4, 10.5, and 10.6.
- D. 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 STRUCTURAL-STEEL MATERIALS

- A. Structural W-Shapes: ASTM A992/A992M
- B. Structural M-Shapes: ASTM A36/A36M.
- C. Structural S-Shapes: ASTM A36/A36M.
- D. Structural T-Shapes: Cut from structural W-shapes, M-shapes, or S-shapes.
- E. Channels and Angles: ASTM A36/A36M.
- F. Structural Plates: ASTM A36/A36M, unless noted on the drawings as ASTM-A572/A572M
- G. Hollow Structural Sections: ASTM A500/A500M, Grade B.
- H. Structural Pipe: ASTM A53/A53M, Grade B, Type E.
- I. Welding Electrodes: Comply with AWS requirements.



## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
  - 2. Use at interior/unfinished locations or as noted on the Structural drawings.
  
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
  - 1. Finish: Hot-dip zinc coating.
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.
  - 3. Use at exterior locations, when embedded in masonry or as noted on the Structural drawings.
  
- 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 (ASTM A 563M) heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
  - 4. Finish: Plain.
  
- E. Threaded Rods: ASTM A 36/A 36M.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
  - 2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
  - 3. Finish: Plain.

## 2.3 PRIMER

- A. Shop Primer: SSPC Paint 15, Type 1, red oxide.
  
- B. Touch-Up Primer: Match shop primer.
  - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03
  
- C. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20.
  - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.

## 2.4 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 capable of developing minimum compressive strength of 7,000 psi at 28 days.

## 2.5 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. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
  - 2. Mark and match-mark materials for field assembly.
  - 3. 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, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. 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.
- F. 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 or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: all bolted connections shall be bearing type (N) and snug tight, unless noted otherwise indicated on the Drawings.
- 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.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces to be field welded.
  - 2. Surfaces of high-strength bolted, slip-critical connections.
  - 3. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 4. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Compatibility: All components/procedures of the AESS paint system shall conform to the coating system specified, submitted, and approved per Division 9. As a minimum identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating and finish coating shall be from a single manufacturer combined in a system documented by the manufacturer with adequate guidance for the fabricator to procure and execute.
- D. 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 (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. 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.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
  - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

## 2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections, unless fabricator is AISC certified.
  - 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:
  - 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.
  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. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
1. Specified shop tests are not required for Work performed by approved fabricator.
- F. 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 and arrangements of anchor rods , bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 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.

#### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates, Bearing Plates 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.

- 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.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and moist cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
  4. Remove forms after grout is set. Trim grout edges to form smooth surface, splayed 45 degrees.
  5. Tighten anchor bolts after grout has cured for a minimum of 3 days.
- 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.
- 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: all bolted connections shall be bearing type (N) and snug tight, unless noted otherwise on the Drawings.
- 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 structural steel is exposed, 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

- B. Owner will engage a qualified special inspector and Testing Agency to perform the special inspections in accordance with applicable code and this section.

Verification and Inspection	Continuous	Periodic	Referenced Standard	IBC Reference
1. Material verification of high-strength bolts, nuts and washers				
a. Identification markings to conform to ASTM standards specified in the approved construction documents		X	Applicable ASTM material specifications; AISC 3609, Section A3.3	
b. Manufacturer's certificate of compliance required		X		
2. Inspection of high-strength bolting				
a. Bearing type connections		X	ASIC 360, Section M2.5	1704.3.3
b. Slip-critical connections	X	X		
3. Material verification of structural steel				
a. Identification markings to conform to ASTM standards specified in the approved construction documents		X	ASTM A6 or ASTM A568	1708.4
b. Manufacturer's certified mill test reports			ASTM A6 or ASTM A568	
4. Material verification of weld filler materials				
a. Identification markings to conform to AWS specification in the approved construction documents			AISC 360, Section A3.5	
b. Manufacturer's certificate of compliance required				
5. Inspection of welding				
a. Structural steel				
1) Complete and partial penetration groove welds	X		AWS D1.1	1704.3.1
2) Multipass fillet welds	X			
3) Single pass fillet welds > 5/16 inch	X			
4) Single pass fillet welds ≤ 5/16 inch		X		
5) Floor and roof deck welds		X	AWS D1.3	
b. Reinforcing steel - Not applicable				
6. Inspection of steel frame joint details for compliance with approved construction documents		X		1704.3.2
a. Details such as bracing and stiffening				
b. Member locations				
c. Application of joint details at each connection				

- A. Bolted Connections: Visually inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."  
 1. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.
- B. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M. . Record types and locations of defects found in work. Record work required and performed to correct deficiencies.

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:
  - 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.
  - d. Radiographic Inspection: ASTM E 94.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 053100 - STEEL DECK

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
  - 1. Steel floor deck.
  - 2. Concrete stops.
  - 3. Steel deck accessories.
  - 4. Bearing plates and angles.

1.2 SUBMITTALS

- A. Shop Drawings:
  - 1. Indicate decking plan, support locations, projections, openings and reinforcement, pertinent details, and accessories.
- B. Product Data: Submit deck profile characteristics and dimensions, structural properties, and finishes.
- C. Design Data: Submit structural calculations for loadings and stresses of steel deck, framing and connections.
- D. Manufacturer's Certificates: Certify that Products meet or exceed specified requirements.
- E. Welders Certificates: Certify welders AWS qualification within the previous 12 months.
- F. Test Reports: Submit reports indicating results of quality control inspections and testing.
- G. LEED Certificate Submittals:
  - 1. None required

1.3 QUALITY ASSURANCE

- A. Calculate structural properties of metal deck in accordance with AISI Specification for the Design of Cold-Formed Steel Structural Members.
- B. Sustainable Building Requirements:
  - 1. None required.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.
  - 1. Manufacturing Location: Within 500 miles of Project site.
- B. Installer: Company specializing in performing the work of this Section with minimum five years documented experience.



- C. Design deck layout, spans, fastening, and joints under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.
- D. Code Required Special Inspection and Testing:
  - 1. Welding: One of the following.
    - a. Current American Welding Society (AWS) Certified Welding Inspector.
    - b. Current AWS Certified Welding Educator.
    - c. Current AWS Certified Welding Engineer or Current American Welding Society/American Institute of Steel Construction (AWS/AISC) Certified Steel Structure Inspector.
  - 2. Nondestructive Testing of Welds:
    - a. Current Nondestructive Testing Level II or III (Magnetic Particle Testing, Liquid Penetrate Testing, Ultrasonic Testing or Radiographic Testing)
      - 1) Level II personnel shall be qualified in accordance with the American Society of Nondestructive Testing (ASNT) document SNT-TC-1A (current edition). Level II certification as determined by a Level III examiner is required for each category.
      - 2) Level III Examiner shall be certified by ASNT unless all level II personnel have a current ASNT Central Certification Program certification. Only then will in-house designation of Level III nondestructive testing personnel be permitted.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

### PART 2 PRODUCTS

#### 2.1 STEEL DECK

- A. Manufacturers:
  - 1. Butler Manufacturing Co.
  - 2. New Columbia Joist Co.
  - 3. Vulcraft Steel Joist.
  - 4. United Steel Deck.
  - 5. Vulcraft Steel Deck.
  - 6. Wheeling Corrugating Co.
  - 7. Or approved equal.
- B. Galvanized Steel: ASTM A653/A653M, structural steel sheet, G60 zinc coating.
- C. Pre-coated Galvanized Steel: ASTM A653/A653M, structural steel sheet, G60 zinc coating, finished with manufacturer's standard shop primer, as selected.
- D. Bearing Plates: ASTM A36/A36M steel, unfinished.
- E. Welding Materials: AWS D1.1 and AWS D1.3 to suit materials being welded.
- F. Galvanizing Repair Paint: SSPC-Paint 20.

- G. Touch-Up Primer: Match shop primer.

## 2.2 FLOOR DECK FABRICATION

- A. Metal Floor Deck: Galvanized sheet steel, configured as follows:
  1. Span Design: Multiple.
  2. Minimum Metal Thickness Excluding Finish: as noted on Drawings.
  3. Nominal Height: 2 inch, fluted profile.
  4. Formed Sheet Width: 32 inch
  5. Side Joints: Lapped.
  6. Flute Sides: Diagonally ribbed for improved concrete bond.
  7. Provide shop-primed steel floor deck where indicated on Drawings.

## 2.3 DECK ACCESSORY FABRICATION

- A. Deck Accessories: Metal closure strips, wet concrete stops, cover plates, gage to match deck gage, galvanized sheet steel; of profile and size as indicated.
- B. Fasteners: corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.
- C. Weld Washers: Mild steel, galvanized, 3/4 inch outside diameter, 1/8 inch thick.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify field conditions are acceptable and are ready to receive work.

### 3.2 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual.
- B. Bear decking on steel supports with 1-1/2 inch minimum bearing. Align and level.
- C. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.
- D. Fasten deck to steel support members at ends and intermediate supports with 5/8 inch puddle welds or mechanical fasteners at 12 inches on center maximum, at bearing ends and parallel with deck flute and at every other transverse flute.
- E. No weld washers for steel 22 gage or thicker.
- F. Perform welding procedures in accordance with AWS D1.1.
- G. Mechanically fasten or weld side laps at 24 inches on center maximum, see Drawings for special conditions.

- H. Reinforce steel deck openings from 6 to 18 inches in size with 1-3/4 x 1-3/4 x 1/4 inch steel angles. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld or mechanically attach to deck at each flute.
- I. Support deck side edges with pour stop.
- J. Install 6 inch minimum wide sheet steel cover plates, of same thickness as decking, where deck changes direction. Fusion weld or mechanically attach 12 inches on center maximum.
- K. Install wet concrete stops at deck edge upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- L. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- M. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- N. Immediately after welding deck and other metal components in position, coat welds, weld blooms, burned areas, and damaged surface coating, with touch-up prime paint per ASTM A 780.

3.3 FIELD QUALITY CONTROL

- A. Perform field special inspections and testing for in accordance with applicable code and this section.

Verification and Inspection	Continuous	Periodic	Referenced Standard	IBC Reference
4. Material verification of weld filler materials				
a. Identification markings to conform to AWS specification in the approved construction documents			AISC 360, Section A3.5	
b. Manufacturer's certificate of compliance required				
5. Inspection of welding				
a. Structural steel				
5) Floor and roof deck welds		X	AWS D1.3	

- B. Welding: Inspect welds in accordance with AWS D1.1.

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
  2. Visually inspect all welds.
- C. Correct defective welds.

- END -

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Cast iron boots

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cast iron boots

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Structural Performance of Aluminum Ladders: Aluminum ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Zinc-Coated Steel Wire Rope: ASTM A 741.
  - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: As indicated.
  - 2. Material: Galvanized steel, ASTM A 653/A 653M.
- I. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- J. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- L. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- M. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- N. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- O. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless-steel fasteners for fastening aluminum.
  - 2. Provide stainless-steel fasteners for fastening stainless steel.
  - 3. Provide stainless-steel fasteners for fastening nickel silver.

4. Provide bronze fasteners for fastening bronze.

- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended.

- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

## 2.7 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

## 2.8 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from cast gray iron in heights indicated with inlets of size and shape to suit existing downspouts.
  - 1. Basis-of-Design Product: Neenah Foundry Company; Catalog No. R-4927-C, Straight; or in profile required by field conditions.
  - 2. Outlets: To discharge into pipe.
- B. Cleanout: All downspout boots shall be provided with access to the interior of the boot for maintenance. As a minimum, an access port of 3 1/2" x 4 1/2" shall be provided. Provide swing door debris evacuator with internal grate meeting ASTM A420/A420M.

## 2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.



2.10 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Galvanize loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.11 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:

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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.2 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055215 – EXTERIOR HANDRAILS AND GUARDRAILS

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 steel handrails
  - 2. Painted steel guardrails

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Steel: 72 percent of minimum yield strength.
  - 2. Stainless Steel: 60 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 ACTION SUBMITTALS

- A. Product Data for each type of product indicated, including finishing materials and color chart for selection.
- A. Shop Drawings: Indicate profiles, sizes, anchorage, and accessories. Indicate materials of each item. Provide plans, elevations, and details as required to clearly illustrate the full scope of work. Include material information, finishes, and types of joinery, fasteners, anchorages, and accessory items.
  - 1. Delegated Design: Include structural analysis data, signed and sealed by a qualified professional engineer responsible for analysis preparation.
  - 2. Verify actual conditions by field measurements before fabrication and indicate measurements on shop drawings.
- B. Samples for Verification: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- B. Welding certificates.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.6, "Structural Welding Code - Stainless Steel."

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

#### 1.8 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items

with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

### 2.2 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 316L.
- B. Pipe: ASTM A 312/A 312M, Grade TP 316L.
- C. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316L.
- D. Welding materials: AWS D1.1, type required for materials being welded.

### 2.3 FASTENERS

- A. General: Provide the following:
  - 1. Steel Railings: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
  - 2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  1. For steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for exterior applications.

## 2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  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 flux immediately.
  4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form changes in direction as follows:

1. As detailed.

- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners, as indicated on Drawings, with finish matching appearance, including color and texture, of railings.

## 2.7 PAINTED STEEL FINISH

- A. Shop Painted Finish: Provide a uniform smooth finish on all railing surfaces using the following products, or approved equal. Fully prepare surfaces in accordance with the manufacturer's recommendations.
  - 1. Primer: Rust-Oleum Commercial C740 System DTM Alkyd Enamel Primer.
  - 2. Finish Coat: Rust-Oleum Commercial C740 System 400 VOC DTM Alkyd Enamel.
  - 3. Color: Black.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

### 3.3 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 8 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.



- C. Grout of anchorage joint to have 1/8-inch (3-mm) buildup, sloped away from post.
- D. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

#### 3.4 ADJUSTING AND CLEANING

- A. Clean steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum of 2.0-mil dry film thickness.

#### 3.5 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch in 10 feet, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

#### 3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055215

## SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Framing with dimension lumber.
  2. Wood blocking, cants, and nailers.
  3. Plywood backing panels.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
1. Preservative-treated wood.
  2. Fire-retardant-treated wood.
  3. Power-driven fasteners.

### 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. Dress lumber, S4S, 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 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. 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 all miscellaneous carpentry unless otherwise indicated:

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 members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
4. Wood floor plates that are installed over concrete slabs-on-grade.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, 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 (3.2 m) beyond the centerline of the burners at any time during the test.

1. 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 D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

C. Application: Treat all miscellaneous carpentry unless otherwise indicated.

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.
4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
5. Plywood backing panels.

### 2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any species.

B. Other Framing: No. 2 grade of any of the following species:

1. Hem-fir (north); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Southern pine or mixed southern pine; SPIB.
5. Spruce-pine-fir; NLGA.
6. Douglas fir-south; WWPA.
7. Hem-fir; WCLIB or WWPA.

8. Douglas fir-larch (north); NLGA.
9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

## 2.5 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.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:
  1. Eastern softwoods, [No. 2] Common grade; NELMA.
  2. Northern species, [No. 2] Common grade; NLGA.

## 2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated.

## 2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Screws for Fastening to Metal Framing: ASTM C954, length as recommended by screw manufacturer for material being fastened.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

## 2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
  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."

## 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-preserved-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 "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Do not splice structural members between supports, unless otherwise indicated.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. 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 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.

END OF SECTION 061053

## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Mineral wool board insulation at exterior cavity walls (assumed product to match existing assembly).
2. Mineral wool batt insulation for miscellaneous voids.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

### PART 2 - PRODUCTS

#### 2.1 MINERAL-WOOL BOARD INSULATION

- A. Basis of Design Product: Subject to compliance with requirements, provide Rockwool Comfortboard 110 or a comparable product by one of the following:
1. Johns Manville, a Berkshire Hathaway company.
  2. Thermafiber, Inc; an Owens Corning Company.
- B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; Type IVB.
- C. Fire Performance:
1. Surface Burning Characteristics to ASTM E 84:
    - a. Flame spread: 0
    - b. Smoke developed: 0
- D. Thermal Resistance (R value/inch at 75 degrees F): 4.0 hr ft/Btu to ASTM C518.
- E. Moisture Resistance:
1. Moisture absorption: 0.28% maximum to ASTM C1104/C1104M.
  2. Water vapor transmission: 35 perm to ASTM E96, Desiccant Method.

- F. Corrosive Resistance:
  - 1. Steel to ASTM C665: Non-corrosive
  - 2. Stainless Steel to ASTM C795: Non-corrosive
- G. Density: 11.0 lb/cu ft to ASTM C303
- H. Compressive Strength: to ASTM C165
  - 1. 584 psf at 10%
  - 2. 1566 psf at 25%
- I. Recycled Content: 40% minimum
- J. Fungi Resistance: To ASTM C1338

## 2.2 MINERAL-WOOL BATT INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
- B. Basis of Design: Manufacturer: Subject to compliance with requirements, provide Rockwool Comfortbatt or a comparable product by one of the following:
  - 1. Johns Manville; a Berkshire Hathaway company.
  - 2. Thermafiber, Inc; an Owens Corning Company
- C. Fire Performance:
  - 1. Surface Burning Characteristics: To ASTM E84
    - a. Flame spread: 0
    - b. Smoke developed: 0
- D. Thermal Resistance: To ASTM C518
- E. Density: 2 lb/ cu ft to ASTM C167
- F. Recycled Content: 40% minimum

## 2.3 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Mineral Wool Insulation: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 0, per ASTM E84.
- B. Insulation Netting: Non-metallic, polypropylene 1/6 -inch (6 strands per inch) mesh insulation netting, to be installed between roof trusses to suspend roof insulation below deck.
- C. Mechanical fasteners in accordance with insulation manufacturer's written recommendations.

- D. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
  - 1. Adhesives should have a VOC content of 70 g/L or less.
- E. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Evaluate existing wall assembly as part of demolition and advise Architect if existing insulation is different from the specified products.
- B. Comply with insulation manufacturer's written instructions applicable to products and applications.
- C. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. 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.

#### 3.2 INSTALLATION OF CAVITY-WALL INSULATION

- A. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches (100 mm) from each corner of board insulation, at center of board, and as recommended by manufacturer.
  - 1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
  - 2. Press units firmly against inside substrates.

END OF SECTION 072100



## SECTION 072500 - AIR AND WEATHER BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Self-adhesive air and weather barrier membrane.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and extent of air and weather barriers. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.
- B. Qualification Data: For Applicator.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air and weather barriers.
- D. Letters of Compatibility: For products used in exterior cavity wall construction, provide letters from product manufacturers stating compatibility with adjacent thermal insulation and flashing materials and accessories.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air and weather barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air and weather barrier within the range of ambient and substrate temperatures recommended by air and weather barrier manufacturer. Protect substrates from environmental conditions that affect performance of air and weather barrier. Do not apply air and weather barrier to a damp or wet substrate or during snow, rain, fog, or mist.

## PART 2 - PRODUCTS

- A. Air/Weather Barrier Membrane for Walls:
1. Basis of Design Product: Subject to compliance with requirements, provide Blueskin SA manufactured by Henry or the following:
    - a. Perm-A-Barrier Wall Membrane, No VP, by Grace.
  2. Product Description: SBS modified bitumen, self-adhering sheet membrane complete with a blue engineered thermoplastic film. For application temperatures down to 10 degrees F use Blueskin® SA LT. For in-service temperatures up to 180 degrees F, use Blueskin® SA HT. Membrane shall have the following physical properties:
    - a. ASTM E2357: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies,
    - b. Air leakage: <0.0001 CFM/ft<sup>2</sup> @1.6 lbs/ft<sup>2</sup> to ASTM E2178 and ASTM E283 and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft<sup>2</sup> for 1 hour and gust wind load pressure of 62.8 lbs/ft<sup>2</sup> for 10 seconds when tested at 1.6 lbs/ft<sup>2</sup> to ASTM E331,
    - c. Vapor permeance: 0.03 perms to ASTM E96 (Desiccant Method),
    - d. Membrane Thickness: 0.0394 inches (40 mils),
    - e. Low temperature flexibility: -22 degrees F to CGSB 37-GP-56M,
    - f. Elongation: 200% to ASTM D412-modified,
    - g. Meets CAN/CGSB-51-33 Type I Water Vapor Permeance requirements

## 2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by air and weather barrier manufacturer for intended use and compatible with air and weather barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Primer: Manufacturer's recommend primer as required.
- C. Fasteners: Self-tapping screws with bonded washers for attachment of exterior rainscreen and masonry cladding to substrate recommended by Manufacturer of air and weather barrier material.
- D. Adhesive: Air and weather barrier manufacturer's standard adhesive as required.
- E. Adhesives: Formulation that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
  1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flexible Flashing: Manufacturer's self-adhered flashing.
- G. Primer for Flexible Flashing: Product recommended by Manufacturer of flexible flashing for substrate.
- H. Sealants: Manufacturer's recommended sealant for laps, penetrations, and repairs.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
  - 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 and weather 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. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air and weather barrier application.
- B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. 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.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air and weather barrier.

### 3.3 INSTALLATION

- A. Install air and weather barrier according to Manufacturer's written instructions and according to recommendations.
  - 1. Seal seams, edges, fasteners, and penetrations.
  - 2. Extend into jambs of openings and seal corners with Manufacturer's recommended transition membrane.
- B. Concrete and Masonry: Install air and weather barrier membrane sheets horizontally against the substrate beginning at base of wall. Align top edge of air and weather barrier sheet immediately below protruding masonry ties or joint reinforcement or ties and firmly adhere in place.

1. Overlap horizontally adjacent sheets a minimum of 6 inches and roll seams.
  2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
  3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
  4. Continue the membrane into all openings in the wall, such as doors, windows, and terminate at points to maintain an airtight barrier that will not be visible from interior.
- C. Seal top of through-wall flashings to air and weather barrier sheet with an additional 6-inch- (150-mm-) wide, strip.
- D. Seal exposed edges of sheets at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- E. Install air and weather barrier sheets and auxiliary materials to form a seal with adjacent construction and to maintain a continuous air and weather barrier.
1. Coordinate the installation of air and weather barrier with installation of roofing membrane and base flashing to ensure continuity of air and weather barrier with roofing membrane.
- F. Connect and seal exterior wall air and weather barrier membrane 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 as indicated and according to manufacturer's tested assembly.
- G. 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.
- H. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.
- I. Do not cover air barrier until it has been tested and inspected by a third-party testing agency as specified herein.
- J. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.
- 3.4 CLEANING AND PROTECTION
- A. Protect air and weather barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air and weather barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air and weather barrier exposed to these conditions for more than 30 days.
  2. Protect air and weather barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air and weather barrier manufacturer.

- B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 072500

## SECTION 074213.23 - METAL COMPOSITE PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes metal composite material panels for entrance canopy and at roof edge conditions (fascia and soffits).

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal composite material panel indicated.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
  - 1. Build mockup of typical corner wall panel, including soffit, approximately 48 inches square by full thickness, including insulation, supports, attachments, and accessories.
    - a. Include four-way joint for metal-faced composite panels.
  - 2. Approval of mockups is for other material and construction qualities specifically approved by the Architect in writing.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by the Architect in writing.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal-faced composite wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
  - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
    - a. Uniform pressure of 30 lbf/sq. ft. (1436 Pa)], acting inward or outward.
- 2.2 Deflection Limits: Metal-faced composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span at the perimeter and 1/60 of the span anywhere in the panel of the span. PANEL MATERIALS
  - A. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
    - 1. Surface: Smooth, flat finish.
    - 2. Exposed Coil Coated Finishes:
      - a. Color Finishes: Coil coated KYNAR® 500 or HYLAR® 5000 based Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene – Alkyl Vinyl Ether (FEVE) resin.
    - 3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
  - B. Panel Sealants: ASTM C 920.

## 2.3 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G40 (Z120) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Subgirts: Manufacturer's standard C- or Z-shaped sections 0.064-inch (1.63-mm) nominal thickness.
- C. Hat-Shaped, Rigid Furring Channels:
  - 1. Nominal Thickness: As required to meet performance requirements.
- D. Cold-Rolled Furring Channels: Minimum 1/2-inch- (13-mm-) wide flange.
  - 1. Nominal Thickness: As required to meet performance requirements.
  - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with nominal thickness of 0.040 inch (1.02 mm).
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.57-mm-) diameter wire, or double strand of 0.048-inch- (1.22-mm-) diameter wire.

## 2.4 MISCELLANEOUS MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal-faced composite wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

## 2.5 METAL-FACED COMPOSITE PANELS

- A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
  - 1. Fire-Retardant Core: Noncombustible, with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3A Composites USA Inc.; Alucobond PE or Alucobond Plus.
    - b. Alcoa Inc.; Reynobond.
    - c. ALPOLIC, Division of Mitsubishi Chemical America, Inc.;
    - d. Copper Sales, Inc.; UNA-FAB Series 1000.



- B. Aluminum-Faced Composite Panels: Formed with 0.020-inch- (0.50-mm-) thick, anodized aluminum sheet facings.
  - 1. Panel Thickness: 0.157 inch (4 mm)
  - 2. Core: Fire retardant.
  - 3. Exterior Finish: Coil Coated Finish.
    - a. Color: Alucobond – Cadet Gray
- C. Attachment System Components: Formed from extruded aluminum
  - 1. Include manufacturer's standard perimeter extrusions with integral weather stripping, panel stiffeners, panel clips, and anchor channels.

## 2.6 ACCESSORIES

- A. Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.
- B. Sealants: Provide manufacturer's standard sealant between panel joints.
  - 1. Color: Match panel colors.

## 2.7 FABRICATION

- A. General: Fabricate and finish metal-faced composite panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal-faced composite panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Metal-Faced Composite Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
  - 1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
  - 2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
  - 3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
  - 4. Dimensional Tolerances:
    - a. Panel Bow: 0.8 percent maximum of panel length or width.
    - b. Squareness: 0.25 inch (5 mm) maximum.

- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal composite material panel manufacturer's written recommendations.

### 3.2 METAL COMPOSITE MATERIAL PANEL INSTALLATION

- A. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
  - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- B. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
  - 1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

### 3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.23

## SECTION 075216 - SBS MODIFIED BITUMINOUS MEMBRANE ROOFING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing system.
2. PMMA-based fluid-applied roofing and flashing systems.
3. Coverboard.
4. Sheet metal counterflashing, roof-edge specialties, and trim.

#### 1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with City, Architect, testing and inspecting agency representative, roofing installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing including installers of roof accessories.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, flashings, cants, membrane terminations, details, and attachments to other work. For insulation, provide plan including crickets, saddles, and tapered edge strips, including slopes.

- C. Samples for Verification:
  - 1. 12-by-12-inch square of base ply and top ply.
  - 2. 12-by-12-inch square of flashing sheet, of color specified.
  
- D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of meeting performance requirements.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For components of membrane roofing system, from ICC-ES.
- B. Sample Warranties: For manufacturer's special warranties.
- C. Qualification Data: For Installer and manufacturer.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.
- B. Inspection Report and Punchlist: Contractor and roofing system manufacturer's post-installation punchlist of open items. Copy of roofing system manufacturer's inspection report of completed roofing installation.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty. Qualified installer must have held such approval or license for a minimum of five years.
- B. Manufacturer Qualifications: A qualified manufacturer that has FMG approval for roofing system identical to that used for this Project.
- C. Acceptable Products: Obtain components for membrane roofing system approved by membrane roofing manufacturer. Provide secondary or accessory products which are acceptable to the manufacturer of the primary roofing products.
- D. Project Acceptance: Submit a completed manufacturer's application for roof guarantee form along with shop drawings of the roofs showing all dimensions, penetrations, and details. The form shall contain all the technical information applicable to the project including deck types, roof slopes, base sheet and/or insulation assemblies (with method of attachment, and fastener type), and manufacturer's membrane assembly proposed for installation. The project must receive approval, through this process, prior to shipment of materials to the project site.

## 1.8 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
- D. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- E. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- F. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- G. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
  - 1. Corner Uplift Pressure: 50.6 lbf/sq. ft. (kPa/sq. m)>.
  - 2. Perimeter Uplift Pressure: 33.6 lbf/sq. ft. (kPa/sq. m)>.
  - 3. Field-of-Roof Uplift Pressure: 20.0 lbf/sq. ft. (kPa/sq. m)>.
- H. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.
- I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

## 1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.
  
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer 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 MULTI-PLY SBS-MODIFIED BITUMEN ROOFING SYSTEM

- A. Source Limitations: Obtain components including roof insulation, fasteners, perimeter metal flashing and edge systems, for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.
  
- B. Roofing Membrane Assembly Description: A cold-applied, roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend.
  
- C. Manufacturers: Basis of Design system Soprema; Sopralene/Elastophane roof system.
  - 1. Provide basis of design product, or equal product by one of the following:
    - a. Siplast; Paradiene 20/30 roof system.
    - b. Johns Manville; DynaLastic 180 roof system.
  
- D. Roofing Membrane Base and Stripping Ply: Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6164/D 6164M, Grade S, Type I, SBS-modified asphalt sheet (reinforced with polyester fabric); smooth surfaced; suitable for application method specified.
  - 1. Basis of Design: Soprema; Sopralene 180 Sanded 2.2.
  - 2. Provide basis of design product, or equal product listed below:
    - a. Soprema; Siplast Paradiene 20
    - b. Johns Manville; Dynalastic 180 Smooth.
  
- E. Granule-Surfaced Roofing Cap Sheet/ Finish Ply: ASTM D 6163, Grade G, Type I, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6164/D 6164M, Grade G, Type I, SBS-modified asphalt sheet (reinforced with polyester fabric) granule surfaced; suitable for application method specified.

1. Basis of Design: Soprema; Elastophane FR GR
  - a. Top Ply Surfacing: Ceramic granule finish, standard Bone White color.
2. Provide basis of design product, or equal product listed below:
  - a. Siplay; Paradiene 30
  - b. Johns Manville; Dynalastic

## 2.2 BASE FLASHING MATERIALS

- A. Backer Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6164/D 6164M, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric; smooth surfaced; suitable for application method specified.
- B. Granule-Surfaced Flashing Sheet: ASTM D 6163, Grade G, Type II, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6164/D 6164M, Grade G, Type II, SBS-modified asphalt sheet (reinforced with polyester fabric) granule surfaced; suitable for application method specified.
  1. Basis of Design: Soprema; Sopralene 180 Sanded 2.2
    - a. Top Ply Surfacing: Ceramic granule finish, standard Bone White color.
  2. Provide basis of design product, or equal product listed below:
    - a. Siplast; Paradiene 40 FR.
    - b. Johns Manville; Dynalastic 180.
- C. Metal-Foil-Surfaced Flashing Sheet: ASTM D 6298, glass-fiber-reinforced SBS-modified asphalt sheet (reinforced with glass fibers); metal-foil surfaced; suitable for application method specified, and as follows:
  1. Foil Surfacing: Aluminum, fluoropolymer- coated finish, of color and gloss selected by Architect from manufacturer's full range.
  2. Basis of Design: Soprema TV Aluminum
  3. Provide basis of design product, or equal product listed below:
    - a. Soprema; Siplast; Veral Aluminum
    - b. Johns Manville; DynaClad.
- D. Liquid Applied Flashing: A liquid and fabric reinforced flashing system created with a stitchbonded polyester scrim and a two-component, moisture cured, elastomeric, liquid applied flashing material, consisting of an asphalt extended urethane base material and an activator.
  1. Basis of Design: Soprema; Alsan RS 230
    - a. Surface Finish: Granule finish, white.
  2. Provide basis of design product, or equal product listed below:
    - a. Siplast; Parapro 123 Flashing System.
    - b. Johns Manville; JM PMMA.

- E. Fleece for Membrane Reinforcement: a non-woven, 110 g/m<sup>2</sup>, needle-punched polyester fabric reinforcement as provided by the membrane system manufacturer.

## 2.3 COVERBOARD

- A. Cover Board: ASTM C 1177/1177M, coated glass-mat high density gypsum sheathing.
  - 1. Manufacturers: Subject to compliance with the following, provide products by one of the following:
    - a. Georgia-Pacific Gypsum LLC, DensDeck Prime Roof Board.
    - b. USG Corporation, Securock UltraLight Coated Glass-Mat Roof Board.
    - c. National Gypsum, DEXcell FA Glass Mat Roof Board.
    - d. Equivalent product by Roofing System manufacturer.
  - 2. Type and Thickness: Regular, thickness as indicated on Drawings.
  - 3. Adhesive: Roofing System manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer

## 2.4 ROOF SPECIALTIES

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous metal receiver with integral drip-edge cleat to engage fascia cover. Provide matching corner units.
  - 1. Manufacturer: provided by roof membrane manufacturer; basis of design product Siplast; Paraguard roof specialties.
  - 2. Metallic-Coated Steel Sheet Fascia Covers: Zinc-coated (galvanized) steel, nominal 24ga thickness.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full range. Color to match standing-seam metal panel and trim.
  - 3. Corners: Factory mitered and continuously welded.
  - 4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
  - 5. Receiver: Manufacturer's standard material and thickness for use with fascia cover.
  - 6. Fascia Accessories: Fascia extenders with continuous hold-down cleats.
- B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation

## 2.5 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
- B. Asphalt Primer: ASTM D 41/D 41M.
- C. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane and base flashings, conforming to ASTM D4479.



- D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- F. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve, color to match roofing.
- G. Perlite Cant Strips: A cant strip composed of expanded volcanic minerals combined with waterproofing binders. The top surface shall be pre-treated with an asphalt-based coating. The face of the cant shall have a nominal 4 inch dimension.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Comply with roofing system manufacturer's written instructions.
- B. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.
- C. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
  - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of light weight fill.
  - 3. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 5. Asphaltic Primer: Prime surfaces with a uniform coating of the specified asphalt primer.

#### 3.2 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (600 mm) in adjacent rows.
  - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
    - a. Locate end joints over crests of steel roof deck.
  - 2. Tightly butt substrate boards together.
  - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.

### 3.3 ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
- D. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  - 1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets with a course of coated felt set in roofing cement with joints and edges sealed.
  - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
  - 3. Remove and discard temporary seals before beginning work on adjoining roofing.
- E. Where roof slope exceeds 3/4 inch per 12 inches (1:18) install roofing membrane sheets parallel with slope.
- F. Use manufacturer's recommended cleaner/solvent, wipe flashing membrane surfaces to be lapped with field membrane. Allow the surface to dry for a minimum of t minutes before continuing work.

### 3.4 BASE PLY INSTALLATION

- A. Install (1) one ply of 80 mill membrane in 25 lb. per sq. of bitumen shingled uniformly to achieve one ply throughout over the prepared substrate. Shingle in proper direction to shed water on each large area of roofing.
- B. Lap ply sheet ends eight inches. Stagger end laps twelve inches minimum.
- C. Extend plies two inches beyond top edges of cants at wall and projection bases.
- D. Install base flashing ply to all perimeter and projection details.

### 3.5 TOP PLY - MODIFIED MEMBRANE APPLICATION

- A. The modified membrane shall then be solidly bonded to the base ply with specified asphalt at the rate of 25 to 30 lbs. per 100 square feet.
- B. The roll must push a puddle of asphalt in front of it with asphalt slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.
- C. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.

- D. Subsequent rolls of modified shall be installed across the roof as above with a minimum of 4” side laps and 8” end laps. The end laps shall be staggered. The modified membrane shall be laid in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
- E. Apply asphalt no more than five feet ahead of each roll being embedded.
- F. Extend membrane 2” beyond top edge of all cants in full moppings of the specified asphalt as shown on the drawings.

### 3.6 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions.
- B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
- D. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.
- E. The entire sheet of flashing membrane must be solidly adhered to the substrate.
- F. Seal all vertical laps of flashing membrane with a three-course application of Flashing Bond and fiberglass mesh.

### 3.7 ROOF SPECIALTIES AND COUNTERFLASHING INSTALLATION

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  - 4. Torch cutting of roof specialties is not permitted.
  - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
  - 2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate not less than recommended by manufacturer to achieve maximum pull-out resistance.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).
- G. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
  - 1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.
  - 2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
  - 3. A roof inspection is required by manufacturer before warranty issue.
  - 4. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
  - 5. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Notification Of Completion: Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date
- F. Final Inspection: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.

3.9 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
- D. Uncured resin is considered a hazardous material. Unused resin must be catalyzed and cured prior to disposal.
- E. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

END OF SECTION 075216

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Formed roof-drainage sheet metal fabrications.
  - 2. Formed wall sheet metal fabrications.
  - 3. Through-wall flashing for masonry cavity walls

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For sheet metal flashing and trim.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Distinguish between shop- and field-assembled work.
  - 3. Include identification of finish for each item.
  - 4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified. Confirm required samples with Architect.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 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 SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

## 1.6 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. 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. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 53 percent.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), 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 B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
  1. Exposed Coil-Coated Finish:
    - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: As selected by Architect from manufacturer's full range, to match other metals where indicated.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; 3 (coarse, polished directional satin) finish.

### 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970
  2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970
  3. Products: Subject to compliance with requirements, provide one of the following:
    - a. GCP Applied Technologies; Grade Ice & Water Shield HT or Ultra.
    - b. Henry Company; Blueskin PE200 HT.
    - c. MFM Building Products Corp.; Ultra HT Wind & Water Seal

### 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, 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 or manufactured item.
1. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight. Sealant must be compatible with adjacent metals.



## 2.5 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. Obtain field measurements for accurate fit before shop fabrication.
  - 2. 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.
  - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. 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 (25 mm) deep, filled with butyl sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

## 2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
  - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
  - 1. Aluminum: 0.032 inch (0.81 mm) thick.
    - a. Color: to match Aluminum Curtainwall, Window, or Storefront system.

## PART 3 - EXECUTION

### 3.1 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

### 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, solder, 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 (300 mm) 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.
- 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. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  - 2. 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 a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

- E. 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 (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel and aluminum sheet.
  2. Do not use torches for soldering.
  3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
  4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

### 3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

### 3.4 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.
- C. 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 (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm).

### 3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042200 "Concrete Unit Masonry" and Section 044313 "Stone Masonry Veneer."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.6 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.

END OF SECTION 076200

## SECTION 077200 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Preformed flashing sleeves.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
- B. Shop Drawings: For roof accessories.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches (300 mm) high, with removable metal hood and slotted metal collar.
  - 1. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
  - 2. Diameter: As indicated.
  - 3. Finish: Manufacturer's standard.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
  - 1. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
  - 2. Height: 13 inches (330 mm).
  - 3. Diameter: As indicated on Drawings.
  - 4. Finish: Manufacturer's standard.

## 2.2 METAL MATERIALS

- A. Aluminum Sheet: ASTM B209 (ASTM B209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
  - 1. Mill Finish: As manufactured.
- B. Aluminum Extrusions and Tubes: ASTM B221 (ASTM B221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- C. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.
- D. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.
- E. Steel Tube: ASTM A500/A500M, round tube.
- F. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- G. Steel Pipe: ASTM A53/A53M, galvanized.

## 2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWWA C2; not less than 1-1/2 inches (38 mm) thick.
- D. Underlayment:
  - 1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D4397.
  - 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
  - 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

- G. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

### 3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

## SECTION 078413 – PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.

#### 1.2 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. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

### 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."

## 2.2 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.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. Grabber Construction Products.
    - c. Hilti, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  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 E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  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.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84
- E. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content:
  1. Architectural Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.

- 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.

## 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.

### 3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
  1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- 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 (150 mm) 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. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Contractor will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. 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.
- C. 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.

END OF SECTION 078413

## SECTION 078443 – JOINT FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

#### 1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
  - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

- 1) UL in its "Fire Resistance Directory."

## 2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. Grabber Construction Products.
    - c. Hilti, Inc.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content:
  1. Architectural Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.
- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, 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 fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill 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 joint firestopping system 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 fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
  - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. 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 - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing agency.
  - 4. Date of installation.

5. Manufacturer's name.
6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Contractor will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint 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 elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078443



## SECTION 079200 – JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Latex joint sealants.
6. Joint sealant backing materials including cylindrical sealant backing and secondary seals.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:

1. Product Data: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

C. 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.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

#### 1.4 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. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

## 1.5 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.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. VOC Content: Sealants and sealant primers shall comply with the following:
1. Architectural sealants shall have a VOC content of 250 g/L or less.
  2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
  3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.
  4. Sealant 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."
- B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's standard range.

### 2.2 SILICONE JOINT SEALANTS

- A. Mildew-Resistant Neutral-Curing Silicone Joint Sealant ASTM C 920.
1. Products: Subject to compliance with requirements, provide product by one of the following:
    - a. BASF Building Systems.

- b. Dow Corning Corporation.
  - c. GE Advanced Materials - Silicones.
  - d. Pecora Corporation.
  - e. Sika Corporation; Construction Products Division.
  - f. Tremco Incorporated.
2. Type: Single component (S) or multicomponent (M).
  3. Grade: Nonsag NS).
  4. Class: 100/50
  5. Uses Related to Exposure: Nontraffic (NT).

### 2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, low modulus; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; 890NST.
    - b. Dow Corning, 790.
    - c. Tremco Incorporated; Spectrum 1.

### 2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; Dynatrol I-XL.
    - b. Sika Corporation; Sikaflex 1A.
    - c. Tremco Incorporated; Dymonic.
- B. 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, provide one of the following:
    - a. BASF Corporation-Construction Systems; MasterSeal SL1.
    - b. Pecora Corporation; NR-201.
    - c. Polymeric Systems, Inc; Flexiprene 952.
    - d. Tremco Incorporated; Vulken 455SL.
- C. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.
  1. Products: Subject to compliance with requirements, provide the following:

- a. Pecora Corporation; Dynatrol II.
  - b. Sika Corporation: Sikaflex 2C
  - c. Tremco Incorporated; Dymeric 240.
- D. Urethane, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, UV stable, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses NT.
- 1. Products: Subject to compliance with requirements, provide the following:
    - a. Pecora Corporation; Dynatrol I-XL.
    - b. Sika Corporation: Sikaflex 15LM.
    - c. Tremco Incorporated; Dymonic 100.
- E. Urethane, M, P, 25, T: Multicomponent, plus 25 percent and minus 25 percent movement capability, traffic-, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T, A, and M.
- 1. Products: Subject to compliance with requirements, provide the following:
    - a. BASF Corporation-Construction Systems; Masterseal SL2.
    - b. Sika Corporation; Sikaflex 2C-SL.
    - c. Tremco Incorporated; THC-901.

## 2.5 PREFORMED JOINT SEALANTS

- A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit varying joint widths as required; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
- 1. Products: Basis-of-Design: Backerseal by EMSEAL Joint Systems, Ltd. Subject to compliance with requirements, provide product by one of the following:
    - a. Dayton Superior Specialty Chemicals.
    - b. Sandell Manufacturing Co.
    - c. Schul International, Inc.
    - d. Willseal USA, LLC.

## 2.6 MILDEW-RESISTANT SILICONE 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, provide the following:
    - a. Dow Corning Corporation; 786 Silicone Sealant.

- b. Pecora Corporation: 898NST.
- c. Tremco Incorporated; Tremsil 200.

## 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, provide one of the following:
    - a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
    - b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600 or Bondaflex Sil-A 700.
    - c. Pecora Corporation; AC-20.
    - d. Sherwin-Williams Company (The); 850A or 950A.
    - e. Tremco Incorporated; Tremflex 834.
- B. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; Chem-Calk 300.
    - b. Pecora Corporation; BC-158.
    - c. Tremco Incorporated; Tremco Butyl Sealant.

## 2.8 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Products: Subject to compliance with requirements, provide product by one of the following:
    - a. Pecora Corporation.
    - b. USG Corporation.

## 2.9 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Secondary Seal to Field-Applied Sealants in Above Grade Vertical Walls and where indicated on drawings:

1. Basis of Design Product: Subject to compliance with requirements, provide Backerseal; EMSEAL Joint Systems, Led.; (800) 526-8365; www.emseal.com.; or an equal product by another manufacturer.
  2. Description: 100% acrylic impregnated expanding foam sealant with internal laminations of closed cell foam.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

## 2.10 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  1. Remove laitance and form-release agents from concrete.
  2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

### 3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
  
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

### 3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Joints between plant-precast architectural concrete paving units.
    - c. Joints in stone paving units, including steps.
    - d. Joints between different materials listed above.
    - e. Other joints as indicated on Drawings.
  
  - 1. Urethane Joint Sealant: Single component, pourable, traffic grade.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
  
- B. Joint-Sealant Application: Exterior joints in horizontal non-traffic surfaces.
  - 1. Joint Locations:
    - a. Roof copings, flashing and counterflashing.
    - b. Other joints as indicated on Drawings.
  
  - 2. Urethane Joint Sealant: Single component, nonsag, NT, Class 100/50
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
  
- C. 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. Perimeter joints between materials listed above and frames of doors windows and louvers.
    - d. Other joints as indicated on Drawings.
  
  - 2. Joint Sealant: Silicone, nonstaining, nonsag, Class 50.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.

- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Other joints as indicated on Drawings.
  1. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 50.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Urethane, single component, nonsag, Class 25, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- F. 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 and windows.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Acrylic latex.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors. Paintable.
- G. 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.
    - b. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, mildew resistant, single component, nonsag, Class 25, neutral curing.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- H. Joint-Sealant Application: Concealed mastics.
1. Joint Locations:



- a. Aluminum thresholds.
  - b. Sill plates.
  - c. Other joints as indicated on Drawings.
2. Joint Sealant: Butyl-rubber based.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.

END OF SECTION 079200

## SECTION 081119 - STAINLESS STEEL DOORS AND FRAMES

### 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. Stainless-steel doors and frames.

- B. Related Requirements:

- 1. Section 042000 "Unit Masonry" for Mortar: Grout fill of metal frames.
  - 2. Section 079200 "Joint Sealants" for Sealing of joints between masonry and frames. Sealing of glazing.
  - 3. Section 081113 "Hollow Metal Doors and Frames" for hollow-metal doors and frames manufactured from steel.
  - 4. Section 087100 "Door Hardware" for door hardware for stainless steel doors.

#### 1.3 REFERENCES

- A. Standards Agencies:

ANSI ..... American National Standards Institute, Inc.,  
1430 Broadway Avenue,  
New York, New York 10018.

ASTM ..... American Society for Testing and Materials,  
100 Barr Harbor Drive, West Conshohocken,  
Pennsylvania 19428.

NAAMM ..... National Association of Architectural Metal Manufacturers,  
600 South Federal Street,  
Chicago, Illinois 60605.

NFPA . . . . . National Fire Protection Association  
1 Batterymarch Park  
P.O. Box 9101  
Quincy, MA 02269

UL . . . . . Underwriters Laboratory,  
333 Pfingsten Road,  
Northbrook, Illinois 60062.

B. Standards:

1. ANSI A250.4-2011, Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Hardware Reinforcings
2. ANSI/NAAMM HMMA 801-12, Glossary of Terms for Hollow Metal Doors and Frames
3. ANSI/NFPA 80 -2015, 16<sup>th</sup> Edition, Standard for Fire Doors and Fire Windows
4. ANSI/NFPA 252-2017, Standard Methods of Fire Tests of Door Assemblies
5. ANSI/UL 10B-2009, Fire Tests of Door Assemblies, 9th edition
6. ANSI/UL 10C-2016, Positive Pressure Fire Test of Door Assemblies, 1st Edition
7. ASTM B117-16 Method of Salt Spray (Fog) Testing.
8. ASTM C 143/C 143M-15a, Test Method for Slump of Hydraulic-Cement Concrete
9. ASTM D1735-14, Practice for Testing Water Resistance of Coating Using Water Fog Apparatus.
10. NAAMM HMMA 802-07, Manufacturing of Hollow Metal Doors and Frames
11. NAAMM HMMA 803-08, Steel Tables
12. NAAMM HMMA 810-08, Hollow Metal Doors
13. NAAMM HMMA 810 TN01-03, Defining Undercuts
14. NAAMM HMMA 820-87, Hollow Metal Frames
15. NAAMM HMMA 820 TN01-03, Grouting Hollow Metal Frames
16. NAAMM HMMA 820 TN02-03, Continuously Welded
17. NAAMM HMMA 830-02, Hardware Selection for Hollow Metal Doors and Frames
18. NAAMM HMMA 831-11, Recommended Hardware Locations for Hollow Metal Doors and Frames
19. ANSI/NAAMM HMMA 866 Commercial Stainless Steel Doors and Frames

- 20. NAAMM HMMA 840-16, Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames
- 21. NAAMM HMMA 850-14, Fire-Rated Hollow Metal Doors and Frames

#### 1.4 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.5 COORDINATION

- A. Coordinate anchorage installation for stainless steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

#### 1.6 TESTING AND PERFORMANCE

- A. Performance Test for Steel Doors and Hardware Reinforcements (ANSI A151.1)
- B. The test specimen shall be a 3' - 0" x 7' - 0" nominal size 1¾" door.
- C. The specimen shall be tested in accordance with the ANSI A151.1 procedure for the Level "A" doors (1,000,000 cycles).
  - 1. The specimen shall be tested in accordance with the ANSI AI 51.1 procedure for twist test which requires a maximum pressure of 300 lbs. pressure.
- D. All test reports shall include a description of the test specimen, procedures used in testing, and indicate compliance with the acceptance criteria of the test.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications.
  - 1. Manufacturer shall provide evidence of having personnel and plant equipment capable of fabricating stainless steel door and frame assemblies of the type specified herein.
- B. Installer Qualifications
  - 1. Installer, trained by the primary product manufacturer, with a minimum of five (5) years documented experience installing stainless steel doors and frame assemblies similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Quality Criteria.

1. Fire labeled doors and frames shall be provided for those openings requiring fire protection ratings as determined and scheduled by the Architect and as required by the applicable Building Code. Such doors and frames shall be constructed as tested in accordance with ASTM E152 (UL-10B) and approved by Underwriters Laboratories or other recognized testing agencies having a factory inspection service.
2. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, hardware or any other reason, the Architect shall be so advised before fabricating work on that item is started.
3. Fabrication methods and product quality shall meet the standards set by the Hollow Metal Manufacturers Association, HMMA, a Division of the National Association of Architectural Manufacturers, NAAMM, as set forth in these specifications.

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
  1. Elevations of each door type.
  2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  4. Locations of reinforcement and preparations for hardware.
  5. Details of each different wall opening condition.
  6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  7. Details of anchorages, joints, field splices, and connections.
  8. Details of accessories.
- C. Samples for Initial Selection: For stainless steel doors and frames.
  1. Samples for Verification (No work to be fabricated until samples are approved):
  2. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
  3. Fabrication: Prepare Samples approximately 8 by 10 inches (203 by 254 mm) corner section to demonstrate compliance with requirements for quality of materials and construction:
    - a. Doors: Show vertical-edge including welding joint of head to jamb, top, and bottom construction; core construction; and hinge, hinge mortise and other applied hardware reinforcement. Include separate section showing glazing if applicable with glazing stop applied to both head and jamb section to show corner joint.

- b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing with stops if applicable.
  - D. Product Schedule: For stainless steel doors and frames, show each door and opening, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule – Show hardware group on schedule. Provide one schedule for the entire project – coordinate schedule for doors and openings of materials specified in other sections.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Deliver stainless steel doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
    - 1. Provide additional protection to prevent damage to finished surface of stainless steel units.
  - B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
  - C. Store stainless steel doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door; ASSA ABLOY.
  - 2. Curries Company; ASSA ABLOY.
  - 3. Greensteel Industries, Ltd.
  - 4. Steelcraft; an Allegion brand.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.70 deg Btu/F x h x sq. ft. or as required to meet LEED Certification requirements when tested according to ASTM C 518.

### 2.3 STAINLESS STEEL DOORS AND FRAMES

- A. Stainless Steel Doors (Extra Heavy-Duty, SDI A250.8, Level 3) and Frames (Maximum Heavy-Duty, SDI A250.8, Level 4): NAAMM-HMMA 866; SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.
  - 1. Doors for Highly Corrosive Environments:

- a. Type: As indicated in the Door and Frame Schedule.
  - b. Thickness: 1-3/4 inches. Doors shall be neat in appearance and free from warping or buckle. Edge bends shall be true and straight and of minimum radius for the thickness of the metal used.
  - c. Face: Face sheets shall be 0.050 in. (1.27 mm) minimum thickness and shall be manufactured from Type 316 stainless steel sheet. Steel shall be free of scale, pitting, coil breaks or surface blemishes, buckles, waves or other defects.
  - d. Edge Construction: Door face sheets shall be joined at their vertical edges by a continuous weld extending the full height of the door with no visible seams on their faces or vertical edges per HMMA-801-83. Joint shall be set toward the center of the vertical edge of the door. A joint at the corner of the door face and the vertical edge is not accepted. The top and bottom edges shall be closed with a continuous channel, also not less than 0.062" (1.59 mm) thickness, welded to both sheets.
  - e. Edge Profiles: Edge profiles shall be provided on both vertical edges of single acting doors as follows: beveled 1/8" in 1 3/4" profile. All hardware for single acting doors shall be designed for beveled edges as specified.
  - f. Core: The door shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.030" minimum thickness, spaced so that the vertical interior webs shall be no more than 6" apart and securely fastened to both face sheets by spot welds spaced a maximum of 5" o.c. vertically. Spaces between stiffeners shall be filled with fiberglass, batt-type material.
  - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
  - h. Exposed Finish: No. 6, Dull Satin
2. Frames for Highly Corrosive Environments:
- a. Materials: Type 316 stainless steel sheet. Minimum thickness: In openings 4' - 0" or less, steel shall be 0.062" (1.59 mm) minimum thickness. In openings greater than 4' - 0", steel shall be 0.078" (1.98 mm) minimum thickness.
  - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
  - c. Construction: Full profile welded.
    - 1) All frames shall have integral stops and be welded units of the sizes and types shown in the contract drawings.
    - 2) Corner joints shall have all contact edges closed tight with miter faces, and either butted or miter stops. Faces and soffits shall be continuously welded and the faces finished smooth. The use of gussets or splice plates as a substitute for welding shall not be acceptable.
    - 3) All other face joints shall be continuously welded and smoothly finished.
    - 4) Minimum depth of stops shall be 5/8". Cut-off stops, where shown, shall be capped at heights as shown in the contract drawings, and jamb joints below cut-off stops shall be welded, filled and ground smooth so that there are no visible seams
    - 5) When shipping limitations so dictate, frames for large openings shall be fabricated in sections designated for assembly in the field by others. Alignment plates or angles shall be installed at each joint. Such components shall be the same thickness as the frame. Field joints shall be made in accordance with approved submittal drawings and shall be field welded.
3. Exposed Finish: No. 6, Dull Satin.



## 2.4 FRAME ANCHORS

### A. Jamb Anchors:

#### 1. Masonry Type:

- a. Frames for installation in new masonry walls shall be provided with adjustable jamb anchors of the same material as the frame. Acceptable jamb anchors shall be TEE-strap or strap and stirrup type no less than 0.075" thickness, or wire type no less than 0.185" in diameter. Straps shall be no less than 2" x 10" in size, corrugated and/or perforated. All frames in new masonry shall be filled with grout. The number of anchors provided on each jamb shall be as follows:

- 1) Frames up to 60" ..., 2 anchors.
- 2) Frames greater than 60" up to 90" ..., 3 anchors.
- 3) Frames greater than 90" up to 96" ..., 4 anchors
- 4) Frames greater than 96", 4 anchors plus 1 for each 24" or fraction thereof over 96" spaced at 24" maximum between anchors (U.L. fire ratings may require additional anchors. Verify building and local code requirements, the most stringent will apply).

- b. Frames for installation in existing masonry or concrete walls shall be prepared for stainless steel expansion bolt type anchors. The preparation shall consist of a countersunk hole for a 3/8" diameter bolt and a spacer from the unexposed surface of the frame to the wall. The spacer shall be welded to the frame and spaced a maximum of 6" from the top and bottom, with intermediate spacing at a maximum of 26" o.c. Fasteners for such anchors shall be stainless steel provided by Installer. All frames installed in exterior openings shall be filled with grout.

2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Post-installed Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

### B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

1. Floor anchors with two holes for fasteners shall be fastened inside jambs with at least four (4) spot welded per anchor.
2. Where so scheduled for finish floor underlayment thickness, adjustable floor anchors, providing no less than 2" height adjustment, shall be fastened in place with at least four (4) spot welds per anchor. Terminate bottom of frames at top of underlayment.
3. Floor anchors shall be of the same material as the frame, with a minimum of 0.078" thickness.

### C. Material: stainless steel sheet – same type as door face.

## 2.5 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent
- B. Stainless Steel Sheet: ASTM A 240/A 240M, austenitic stainless-steel, Type 316.

- C. Steel Sheet: ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, commercial steel, Type B.
- D. Metallic-Coated Steel Sheet: ASTM A653/A 653M, commercial steel, with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- E. Foam-Plastic Insulation: Manufacturer's standard polystyrene board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM 84. Enclose insulation completely within door.
- F. Mineral-Fiber Insulation: Insulation made of rock-wool fibers, slag-wool fibers, or glass fibers.
- G. Inserts, Bolts, and Fasteners: Stainless Steel where noted, otherwise, Hot-dip galvanized according to ASTM A 153/A 153M.
- H. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- J. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102) as measured according to ASTM C 143/C 143M.

## 2.6 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Stainless Steel Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding
  - 2. Provide stainless steel countersunk sheet metal screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.for exposed fasteners unless otherwise indicated.
  - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
  - 4. Terminated Stops: Terminate stops [6 inches (152 mm)] <Insert dimension> above finish floor with a [45] [90]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

5. Frames for installation in masonry wall openings more than 4' - 0" in width shall have an angle or channel stiffener made from the same material as the frame that shall be factory welded into the head when the head is to be grouted. Such stiffener shall not be used as lintel or load bearing member, shall not be longer than the opening width but not shorter than 1" and they shall not be less than 0.105" in thickness.
  6. Plaster guards shall be provided and welded in place at all hardware mortises on frames to be set in masonry or concrete openings. They shall be made from the same material as the frame with not less than 0.019" thickness.
  7. Where specified or scheduled, Stainless Steel Infill Panels will be secured flush to the outside of exterior frames or flush to the secure side of interior frames. The Infill Panels will be anchored to the frame sections with loose stops and moldings on inside or non-secure side of Stainless Steel frames. Provide stops for installation with stainless steel countersunk sheet metal screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Comply with BHMA A156.115 for preparing stainless steel doors and frames for hardware.
  2. Where nontemplated, mortised, and surface-mounted door hardware is to be applied, reinforce doors and frames, with all drilling and tapping done in the field, to receive:
    - a. Minimum thickness for hardware reinforcements in doors as follows:
      - 1) Full mortise hinges and pivots, 0.180".
      - 2) Reinforcements for lock fronts, concealed holders, or surface mounted closer, 0.105".
      - 3) Internal reinforcements for all other surface applied hardware 0.075".
    - b. Minimum thickness for hardware reinforcements in frames as follows:
      - 1) Hinge and pivot reinforcements ..., 0.195" x 1¼" >10" in length.
      - 2) Strike reinforcements ..., 0.105"
      - 3) Closer reinforcements ..., 0.105"
      - 4) Flush bolt reinforcements ..., 0.105"
      - 5) Reinforcements for surface applied hardware ..., 0.105"
      - 6) Reinforcements for hold open arms ..., 0.105"
      - 7) Reinforcements for surface panic devices ..., 0.105"
  3. In cases where electrically operated hardware is required, and indicated on architectural door schedule, conduit, hardware enclosures and/or junction boxes within the door shall be provided. Access plates where required shall be the same thickness as the door and fastened with a minimum of (4) #8-32 Stainless Steel machine screws or #6 Stainless Steel metal screws, not to exceed 12" o.c.

## 2.7 STAINLESS STEEL FINISHES

- A. Stainless Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

- B. Finish: No. 6, Dull Satin.
- C. Grain Direction: For finishes exhibiting grain, run grain vertically on door faces and frame jambs.

## 2.8 CLEARANCES AND TOLERANCES

- A. Edge clearances for swinging doors shall not exceed the following
  1. Between doors and frames, at head and jambs ...,  $\frac{3}{16}$ ".
  2. Between edges of pairs of doors ...,  $\frac{1}{16}$ "
  3. At door sills where a threshold is used ...,  $\frac{3}{8}$ ". Measured from bottom of door to top of threshold.
  4. At door sills where no threshold is used ...,  $\frac{3}{4}$ ".
  5. Between door bottom and nominal surface of floor coverings at fire rated openings as provided in NFPA 80-990, Paragraph 2.5.5.
- B. Manufacturing tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 866; tolerances shall be maintained within the following limits:
  1. Frames for single door or pair of doors:
    - a. Thickness of sheet metal ..., +0.015"; —0.007".
    - b. Width, measured between rabbets at the head. Nominal opening width ..., +  $\frac{1}{16}$ "; —  $\frac{1}{32}$ ".
    - c. Height (total length of jamb rabbet). Nominal opening height ..., +  $\frac{3}{64}$ ".
    - d. Cross sectional profile dimensions.
      - 1) Face ..., +  $\frac{1}{32}$ ".
      - 2) Stop ...,  $\pm \frac{1}{32}$ ".
      - 3) Rabbet ..., +  $\frac{1}{32}$ ".
      - 4) Depth ..., +  $\frac{1}{32}$ ".
      - 5) Throat ...,  $\pm \frac{1}{16}$ ". Frames overlapping walls to have throat dimension  $\frac{1}{8}$ " greater than dimensioned wall thickness to accommodate irregularities in wall construction.
  2. Doors:
    - a. Thickness of sheet metal ... +0.015"; —0.007".
    - b. Width ..., +  $\frac{3}{64}$ "
    - c. Height ..., +  $\frac{3}{64}$ "
    - d. Thickness ..., +  $\frac{1}{16}$ "
    - e. Hardware cutout dimensions. Template dimensions ..., +0.015"; —0"
    - f. Hardware location ..., +  $\frac{1}{32}$ "

## 2.9 HARDWARE LOCATIONS

1. The location of hardware on doors and frames shall be coordinated with the locations indicated in Specification Section 087100 Door Hardware.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove wraps or covers from doors and frames upon delivery at the building site. Record any damage or error in the stainless steel doors and frames delivered to the job site, and notify the manufacturer/supplier on writing to maintain warranty and/or fire label
- B. Promptly clean and touch up any scratches or disfigurement caused in shipping or handling.
- C. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Check doors and frames for correct size, swing, fire rating and opening number.
- D. Store door and frame materials in a dry location on planks at least 4" off ground or 2" off floor slab. Doors shall be stored in a vertical position and spaced at least  $\frac{3}{8}$ " by wood strip or blocking. Materials shall be covered to protect them from damage but in such a manner as to permit air circulation. Place no more than 5 doors or welded frames in a group. In the case of multi-opening frames, no more than three units should be stored in a group, to avoid serious racking or other damage to the bottom of the frame
- E. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. General: Install stainless steel doors and frames plumb, rigid, properly aligned, and braced securely until permanent anchors are set. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. The installer shall perform the following:
  - 1. Prior to installation, the area of floor on which the frame product is to be installed, and within the path of the door swing, shall be checked for flatness.
  - 2. Prior to installation, all interior surfaces of perimeter frame product sections to be installed in masonry or concrete walls shall be isolated and protected from grout and antifreeze agents.
- C. Doors and frame product shall be checked for correct size, swing, fire rating and opening number. Permissible installation tolerances shall not exceed the following:
  - 1. Squareness,  $\pm 1/16$ " measured on a line, 90 degrees from one jamb, at the upper corner of the frame at the other jamb.
  - 2. Squareness,  $\pm 1/16$ " measured on a line, 90 degrees from one jamb, at the upper corner of the frame at the other jamb.
  - 3. Twist,  $\pm 1/16$ " measured at face corners of jambs on parallel lines perpendicular to the plane of the wall.
  - 4. Plumbness,  $\pm 1/16$ " measured on the jamb at the floor.
- D. Stainless Steel Frames: Comply with NAAMM-HMMA 840.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  2. Fire-Rated Openings: Install frames according to NFPA 80.
  3. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  4. Hardware must be applied in accordance with hardware manufacturer's templates and instructions.
  5. Plaster guards and junction boxes are intended to protect hardware mortises and tapped mounting holes from masonry grout of 4" maximum slump consistency which is hand troweled in place. If a light consistency grout (greater than 5" slump when tested in accordance with ASTM C 143/C 143M) is to be used, special precautions must be taken in the field by the installation contractor to protect the aforementioned.
  6. Frame products are not intended or designed to act as forms for grout or concrete. Grouting of hollow metal sections shall be done in "lifts" or precautions shall be otherwise taken by the contractor to ensure that frames are not deformed or damaged by the hydraulic forces that occur during this process.
  7. Any grout or other bonding material shall be promptly cleaned off of frames or doors following installation. Hollow metal surfaces shall be kept free of grout, tar, or other bonding material or sealer.
  8. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  9. Exposed hollow metal surfaces which have been scratched or otherwise marred during installation, cleaning, and/or field welding, shall promptly be finished smooth, cleaned, treated for maximum paint adhesion and touched up with a rust inhibitive primer comparable to and compatible with the shop applied primer and finish paint specified in Section 099000.
- E. Stainless steel Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.

### 3.3 ADJUSTING AND CLEANING

- A. Clean grout and other bonding material off stainless steel doors and frames immediately after installation.
- B. Stainless Steel Touchup: Immediately after erection, smooth any scratched or damaged areas of stainless steel; polish to match undamaged finish.

END OF SECTION

## SECTION 083113 - ACCESS DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes access doors and frames for ceilings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

#### 2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Regional Materials: To greatest extent possible, access door and frame products shall be manufactured within 100 miles (160 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide products by Karp Associates, Inc. or comparable product by one of the following:
  - 1. Acudor Products, Inc.
  - 2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
  - 3. Larsen's Manufacturing Company.
  - 4. Milcor Inc.
  - 5. Nystrom, Inc.



- C. Source Limitations: Unless special circumstances dictate and are approved by the Owner, all access door assemblies shall be from a single manufacturer.
- D. Flush Access Doors with Concealed Flanges:
  - 1. Basis-of-Design Product: Karp Associates, Inc.; Model KDW.
  - 2. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
  - 3. Locations: Non-fire-rated gypsum wall board wall and ceiling construction.
  - 4. Door Size: As indicated or required.
  - 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
    - a. Finish: Factory prime.
  - 6. Frame Material: Same material and thickness as door.
  - 7. Hinges: Manufacturer's standard.
  - 8. Hardware: Lock.
- E. Hardware:
  - 1. Lock: Mortise cylinder.

## 2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- E. Frame Anchors: Same type as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
  - 1. For cylinder locks, furnish two keys per lock and key all locks alike.
  - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

## 2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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.
- D. Steel and Metallic-Coated-Steel Finishes:
  - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

### 3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

## SECTION 084113 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed exterior storefront systems.
2. Exterior manual-swing entrance doors.
3. Interior aluminum-framed storefront systems and doors.

B. Related Sections:

1. Section 088000 “Glazing” for glass in aluminum-framed entrances and storefronts.
2. Section 085113 Aluminum Windows – to be same manufacturer as ALSF

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include manual hardware.

C. Samples: For each exposed finish required.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

- C. Source quality-control reports.
- D. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A manufacturer capable of fabricating aluminum storefront systems that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.
- B. **Installer Qualifications:** An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. **Product Options:** Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- D. **Obtain field measurements prior to fabrication of frame units.** If field measurements will not be available in a timely manner coordinate planned measurements with the work of other sections.
  - 1. Note whether field or planned dimensions were used in the creation of the shop drawings.

#### 1.6 WARRANTY

- A. **Special Warranty:** Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. **Warranty Period:** Two years from date of Substantial Completion.
- B. **Special Finish Warranty:** Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design aluminum-framed entrances and storefronts.
  1. Design Wind Pressures: As indicated on Drawings.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Noise or vibration created by wind and by thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Failure of operating units.
- C. Deflection of Framing Members: At design wind pressure, as follows:
  1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
    - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
  3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

- a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).
- D. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
  2. Entrance Doors:
    - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
    - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.36 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
  2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have SHGC of no greater than 0.26 as determined according to NFRC 200.
  3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 56 for frame and 55 for glass determined according to NFRC 500.
- H. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows.
1. Outdoor-Indoor Transmission Class: Minimum 30.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following products by Kawneer North America; an Alcoa company: Trifab 451UT 2" x 4 1/2" (for exterior storefronts); and Trifab VersaGlaze 450 with 2-inch sightline (for interior storefronts) or comparable product by one of the following:
  - 1. Wausau Window and Wall Systems.
  - 2. YKK AP America Inc.
- B. Source Limitations: Obtain all components of each aluminum-framed entrance and storefront system and glazed aluminum curtainwalls, including framing, venting windows and accessories, from single manufacturer.
- C. Provide same manufacturer for aluminum windows.

## 2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally broken for exterior units.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: Center.
  - 4. Fabrication Method: Screw Spline or Shear Block.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
  - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
    - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    - d. Structural Profiles: ASTM B 308/B 308M.
  - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
    - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 2-inch overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
  - a. Provide nonremovable glazing stops on outside of door.

## 2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

## 2.6 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

## 2.7 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
  1. Sealant shall have a VOC content of 250 g/L or less.
  2. Sealant 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."

## 2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.



- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing panels.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At exterior doors, provide compression weather stripping at fixed stops.
  - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.9 ALUMINUM FINISHES

- A. Color Fluoropolymer Hardcoat Finish: AAMA 2604, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 1. Exterior ALSF Color at Vestibule: Sapphire Ice.
  - 2. Interior ALSF Color: Dove Gray

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for 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. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

### 3.3 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
  2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
  4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 084113

## SECTION 085113 – ALUMINUM WINDOWS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes aluminum windows for exterior locations in fixed assemblies.
- B. Related Sections
  - 1. Section 088000 “Glazing” for glass in aluminum-framed entrances and storefronts.
  - 2. Section 084113 Aluminum Framed Storefront and Entrances– to be same manufacturer as aluminum windows

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

#### 1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. Window: 2 years from date of Substantial Completion.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope. Installer should confirm dimensions with existing masonry openings on site prior to manufacture of window units.

- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

## PART 2 - PRODUCTS

### 2.1 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: AW90
  - 2. Minimum Performance Grade: HC90
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.60 Btu/sq. ft. x h x deg F.
- D. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 55.
- E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 2 for basic protection.
  - 1. Large-Missile Test: For glazing located within 30 feet of grade.
  - 2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.

### 2.2 ALUMINUM WINDOWS

- A. Basis of Design Product: Subject to compliance with requirements, provide Kawneer Company Inc, 8225TL Thermal Windows, fixed.
- B. Types: Fixed, Refer to drawings.
- C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
  - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins 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. Glazing
  - 1. Refer to section 088000 Glazing for glass units and glazing requirements applicable to glazed aluminum window units.

- E. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
  - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- F. Source Limitations: Obtain all components of each aluminum window including framing, venting windows and accessories, from single manufacturer.
- G. Provide same manufacturer for aluminum framed entrances and storefronts.

## 2.3 ACCESSORIES

- A. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- B. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

## 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. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. 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 ALUMINUM FINISHES

- A. Color Fluoropolymer Hardcoat Finish: AAMA 2604, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 1. Color: At Office – Summer Yellow.
  - 2. Color: At all other windows: Dove Gray

## PART 3 - EXECUTION

### 3.1 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.
- E. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- F. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085113

## SECTION 085656 – SECURITY SCREENS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Security screens for installation at exterior windows where indicated on drawings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of security screen specified.
- B. Shop Drawings: Showing details of attachment to surrounding materials and elevations showing scope of the project. Include key number to owner's existing keying system on shop drawings.
- C. Samples: For each product and finish specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: actively engaged in the fabrication of specified items for a minimum of five (5) years prior to the bid date.
- B. Performance and testing must comply with impact test, sag test and forced entry resistance test of SMA 6001-02. Manufacturer must submit the AAMA Notice of Product Certification in compliance with CFR 200.935 as "Security Screen - Heavy". Security screens must provide Threat Level 5, Heavy Vandalism protection.

### PART 2 - PRODUCTS

#### 2.1 SECURITY SCREENS

- A. Security Screen: Hinged metal security screens for installation at storefront and curtainwall areas.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Steel Narrowline Security Screen, Model S-NR5-O, by Kane Architectural Innovations, or equal. Provide surface or reveal mounting as indicated on Drawings or as required for appropriate installation of security screens.



2. Level 5 (heavy vandalism)
  3. Roto-lift emergency egress release.
  4. Keyed cam lock to match owner's existing keying.
- B. Main Frame Construction: The main frame rails shall be of not less than 16-gauge 1" [25.4mm] x 1" [25.4] seamless welded galvanized steel tubing with high strength die cast metal corners which are pneumatically inserted into the frame ends with an interference fit.
1. A removable face plate, extruded from 6063-T6 aluminum alloy, .062-inch thick .212 lbs./ft., shall be attached to the sides of the main frame using square drive Tek screws. The faceplate corner bead shall integrate with the sub-frame to conceal the hardware and fasteners.
- C. Sub Frame Construction: The sub-frame shall be of channel design, extruded from 6063-T6-aluminum alloy. Weight shall be .515 lbs./ft. Wall thickness shall be .090 inch. The corners of the subframe shall be mitered, secured by an internal tension coupling assembly and shall be resistant to both torsion and flexural failure.
1. The sub-frame shall have a continuous groove retaining a combination cushioning strip/insect shield. The depth of the subframe shall be no more than 1 3/4".
- D. Infill Panel: Perforated panel in 16 gauge mill-galvanealed steel, with round perforations.
1. Openness: 63%.
  2. Attachment: The perforated panel shall be attached to the mainframe with hex-head Tek Screws.
- E. Finishes: The frame, sub-frame, faceplates, scribe angles, and infill panels shall be thoroughly cleaned in a 5-step bonderizing process. An electrostatically applied thermoplastic, polyester powder coating (2.5 mil min. thickness) shall be applied and baked to a hard mar-resistant finish. Coating shall meet or exceed AAMA 2603.
1. Color: Frame and subframe color shall match color selected for aluminum storefronts and windows and shall be a custom color if necessary to do so.
  2. Infill Panel Color: Black.
- F. Hardware:
1. Each screen shall be provided with two or more concealed 13-gauge, electroplated steel hinges with 1/4" [6.35] diameter hardened, loose stainless steel pins and integral compression guards. 13-gauge stainless steel hinge available.
  2. Each screen shall include adjustment screws (1/4-20 x 3/4 Philips pan head thread cutting fastener) and .062-inch thick aluminum scribes. The 1-3/16" [30.1625] x 3/4" [19.05] scribes shall be supplied at the head and jambs if required.
  3. Each screen shall come fully assembled and tested from the factory.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that openings fit allowable tolerance, are plumb, level, provide a solid anchoring surface and comply with approved shop drawings.

3.2 INSTALLATION

- A. Install in accordance with approved shop drawings and specifications.
- B. Plumb and align faces in a single plane and erect screens square and true, adequately anchored to structure.
- C. After completion of installation, screens shall be adjusted, in working order and cleaned.

END OF SECTION 085656

## SECTION 08 71 00 – DOOR HARDWARE

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
  - a. "Metal Doors and Frames"
  - b. "Flush Wood Doors"
  - c. "Stile and Rail Wood Doors"
  - d. "Interior Aluminum Doors and Frames"
  - e. "Aluminum-Framed Entrances and Storefronts"
  - f. "Stainless Steel Doors and Frames"
  - g. "Special Function Doors"
  - h. "Entrances"
6. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
7. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
8. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

#### 1.02 REFERENCES

A. UL, LLC

1. UL 10B - Fire Test of Door Assemblies

2. UL 10C - Positive Pressure Test of Fire Door Assemblies
  3. UL 1784 - Air Leakage Tests of Door Assemblies
  4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
1. Sequence and Format for the Hardware Schedule
  2. Recommended Locations for Builders Hardware
  3. Keying Systems and Nomenclature
  4. Installation Guide for Doors and Hardware
- C. NFPA – National Fire Protection Association
1. NFPA 70 – National Electric Code
  2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
  3. NFPA 101 – Life Safety Code
  4. NFPA 105 – Smoke and Draft Control Door Assemblies
  5. NFPA 252 – Fire Tests of Door Assemblies
- D. ANSI - American National Standards Institute
1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
  2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
  3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
  4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
  5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

### 1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
  - a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
  - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
  - c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
  - a. Wiring Diagrams: For power, signal, and control wiring and including:
    - 1) Details of interface of electrified door hardware and building safety and security systems.

- 2) Schematic diagram of systems that interface with electrified door hardware.
  - 3) Point-to-point wiring.
  - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
- a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:
- a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
  - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
  - c. Indicate complete designations of each item required for each opening, include:
    - 1) Door Index: door number, heading number, and Architect's hardware set number.
    - 2) Quantity, type, style, function, size, and finish of each hardware item.
    - 3) Name and manufacturer of each item.
    - 4) Fastenings and other pertinent information.
    - 5) Location of each hardware set cross-referenced to indications on Drawings.
    - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    - 7) Mounting locations for hardware.
    - 8) Door and frame sizes and materials.
    - 9) Degree of door swing and handing.
    - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
  - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
  - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
  - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
  - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
  - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
  - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
  - b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
  - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
  - b. Catalog pages for each product.
  - c. Final approved hardware schedule edited to reflect conditions as installed.
  - d. Final keying schedule
  - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
  - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
  - a. fire door assemblies, in compliance with NFPA 80.
  - b. required egress door assemblies, in compliance with NFPA 101.

#### 1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
  - a. For door hardware: DHI certified AHC or DHC.
  - b. Can provide installation and technical data to Architect and other related subcontractors.

- c. Can inspect and verify components are in working order upon completion of installation.
    - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
  4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Certifications:
  1. Fire-Rated Door Openings:
    - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
    - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
  2. Smoke and Draft Control Door Assemblies:
    - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
    - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
  3. Electrified Door Hardware
    - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
  4. Accessibility Requirements:
    - a. Comply with governing accessibility regulations cited in “REFERENCES” article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.
- C. Pre-Installation Meetings
  1. Keying Conference
    - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      - 2) Preliminary key system schematic diagram.
      - 3) Requirements for key control system.
      - 4) Requirements for access control.
      - 5) Address for delivery of keys.
  2. Pre-installation Conference

- a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - b. Inspect and discuss preparatory work performed by other trades.
  - c. Inspect and discuss electrical roughing-in for electrified door hardware.
  - d. Review sequence of operation for each type of electrified door hardware.
  - e. Review required testing, inspecting, and certifying procedures.
  - f. Review questions or concerns related to proper installation and adjustment of door hardware.
3. Electrified Hardware Coordination Conference:
- a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

#### 1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.



- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

#### 1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
  - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
  - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    - a. Mechanical Warranty
      - 1) Locks
        - a) Schlage L Series: 3 years
        - b) Falcon: 10 years
      - 2) Exit Devices
        - a) Falcon: 10 years
      - 3) Closers
        - a) LCN 4000 Series: 30 years

#### 1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
  - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance in section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

## 2.02 MATERIALS

### A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

### B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

### C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

## 2.03 HINGES

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Stanley FBB series
2. Acceptable Manufacturers and Products:
  - a. Ives 5BB series
  - b. Hager BB1191/1279 series
  - c. McKinney TB series

### B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.

3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
  - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
  - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
  - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
  - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
9. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
  - a. Steel Hinges: Steel pins
  - b. Non-Ferrous Hinges: Stainless steel pins
  - c. Out-Swinging Exterior Doors: Non-removable pins
  - d. Out-Swinging Interior Lockable Doors: Non-removable pins
  - e. Interior Non-lockable Doors: Non-rising pins
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

## 2.04 CONTINUOUS HINGES

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Stanley
2. Acceptable Manufacturers:
  - a. Ives
  - b. Hager

### B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.

4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

## 2.05 FLUSH BOLTS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Rockwood
  - b. McKinney

### B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

## 2.06 MORTISE LOCKS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Schlage L9000 series
2. Acceptable Manufacturers and Products:
  - a. Best 45H series
  - b. Corbin-Russwin ML2000 series

### B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.

3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches. Provide motor based electrified locksets that comply with the following requirements:
  - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
  - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
  - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
  - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
  - e. Connections – provide quick-connect Molex system standard.
8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
  - a. Lever Design: 03

## 2.07 MORTISE LOCKS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Falcon MA series
2. Acceptable Manufacturers and Products:
  - a. Corbin-Russwin ML2000 series
  - b. Sargent 8200 series

### B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
3. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

6. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
  - a. Lever Design: Sutro

## 2.08 EXIT DEVICES

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Falcon 24/25 series
2. Acceptable Manufacturers and Products:
  - a. Sargent 19-43-GL-80 series
  - b. Von Duprin 35A/98 series

### B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer’s approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

## 2.09 CYLINDERS

### A. Manufacturers:

1. Scheduled Manufacturer and Product:
    - a. High Security Best #5C7DD
  2. Acceptable Manufacturers and Products:
    - a. No Substitute
- B. Requirements:
1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

## 2.10 KEYING

- A. Scheduled System:
1. Existing non-factory registered system:
    - a. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:
      - 1) Firm Name:
      - 2) Contact Person:
      - 3) Telephone:
- B. Requirements:
1. Construction Keying:
    - a. Replaceable Construction Cores. (OPTION: if using temporary construction cores in IC core cylinder in either F/S or S/F.)
      - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
        - a) 3 construction control keys
        - b) 12 construction change (day) keys.
      - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
  2. Permanent Keying:
    - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      - 1) Master Keying system as directed by the Owner.
    - b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
    - c. Provide keys with the following features:
      - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).

- 3) OPTION: Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
- d. Identification:
  - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
  - 2) Identification stamping provisions must be approved by the Architect and Owner.
  - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
  - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
  - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
  - 1) Change (Day) Keys: 3 per cylinder/core.
  - 2) Master Keys: 6.

## 2.11 KEY CONTROL SYSTEM

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Telkee
2. Acceptable Manufacturers:
  - a. HPC
  - b. Lund

### B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
  - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
  - b. Provide hinged-panel type cabinet for wall mounting.

## 2.12 DOOR CLOSERS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. LCN 4010/4110/4020 series



2. Acceptable Manufacturers and Products:
  - a. Corbin-Russwin DC8000 series
  - b. Sargent 281 series
  
- B. Requirements:
  1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
  2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
  3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
  4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
  5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
  6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
  7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
  8. Pressure Relief Valve (PRV) Technology: Not permitted.
  9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
  10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

## 2.13 DOOR CLOSERS – HIGH SECURITY

- A. Manufacturers and Products:
  1. Scheduled Manufacturer and Product:
    - a. LCN 4210/4510 Smoothee Series
  2. Acceptable Manufacturers and Products:
    - a. No Substitute
  
- B. Requirements:
  1. Provide high security door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
  2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
  3. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

4. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
5. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
6. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
9. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

#### 2.14 DOOR TRIM

##### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives.
2. Acceptable Manufacturers:
  - a. McKinney
  - b. Rockwood

##### B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

#### 2.15 PROTECTION PLATES

##### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Trimco
  - b. Mckinney

##### B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

## 2.16 EDGE GUARDS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Trimco
  - b. McKinney

### B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick.
2. Furnish with sheet metal or wood screws, finished to match plates.
3. At fire rated doors, edge guards with UL label.
4. Provide edge guards sized for the full height of the door and to suit door edge conditions.
5. Provide edge guards mortised for the edge mounted hardware specified in the associated hardware group.

## 2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturers:
  - a. Glynn-Johnson
2. Acceptable Manufacturers:
  - a. Sargent

### B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

## 2.18 DOOR STOPS AND HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Trimco
  - b. McKinney

- B. Provide door stops at each door leaf:
  - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
  - 2. Where a wall stop cannot be used, provide universal floor stops.
  - 3. Where wall or floor stop cannot be used, provide overhead stop.
  - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

## 2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

### A. Manufacturers:

- 1. Scheduled Manufacturer:
  - a. Zero International
- 2. Acceptable Manufacturers:
  - a. McKinney
  - b. Reese

### B. Requirements:

- 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
- 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
- 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
- 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## 2.20 SILENCERS

### A. Manufacturers:

- 1. Scheduled Manufacturer:
  - a. Ives
- 2. Acceptable Manufacturers:
  - a. Rockwood
  - b. Trimco

### B. Requirements:

- 1. Provide "push-in" type silencers for hollow metal or wood frames.
- 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
- 3. Omit where gasketing is specified.

## 2.21 FINISHES

- A. Finish: BHMA 626/652 (US26D); except:
  - 1. Hinges at Exterior Doors: BHMA 630 (US32D)
  - 2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
  - 3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
  - 4. Protection Plates: BHMA 630 (US32D)
  - 5. Overhead Stops and Holders: BHMA 630 (US32D)
  - 6. Door Closers: Powder Coat to Match
  - 7. Wall Stops: BHMA 630 (US32D)
  - 8. Latch Protectors: BHMA 630 (US32D)
  - 9. Weatherstripping: Clear Anodized Aluminum
  - 10. Thresholds: Mill Finish Aluminum

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
  - 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
  - 2. Field modify and prepare existing doors and frames for new hardware being installed.
  - 3. When modifications are exposed to view, use concealed fasteners, when possible.
  - 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
    - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

### 3.03 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
  - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
  - 1. Conduit, junction boxes and wire pulls.
  - 2. Connections to and from power supplies to electrified hardware.
  - 3. Connections to fire/smoke alarm system and smoke evacuation system.
  - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
  - 5. Connections to panel interface modules, controllers, and gateways.
  - 6. Testing and labeling wires with Architect's opening number.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

- M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- R. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.04 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.
  - 1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
  - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
  - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

### 3.05 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

### 3.06 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules,

specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

- B. Discrepancies, conflicting hardware, and missing items are to 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.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:




END OF SECTION



Hardware Group No. 00

For use on Door #(s):  
 123B








Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	661HD	AL	STA
2	EA	PUSH/PULL BAR	9103EZHD-33"-12"-NS	 626	IVE
2	EA	H-SEC SURFACE CLOSER	4211 HCUSH	 689	LCN
1	EA	RAIN DRIP	142AA	 AA	ZER
1	EA	PERIMETER GASKETING	BY ALUMINUM DOOR MANUFACTURER		

Hardware Group No. 00A

For use on Door #(s):  
 106                    107

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	FBB179 4.5" x 4.5"	626	STA
1	EA	PUSH PLATE	8200 4" X 16"	 630	IVE
1	EA	PULL PLATE	8305 10" 6" X 16"	 630	IVE
1	EA	SURFACE CLOSER	4111 RW/62A	 689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS	 605	IVE
1	EA	MOP PLATE	8402 4" X 1" LDW B-CS	 630	IVE
1	EA	WALL STOP	WS406/407CCV	 626	IVE
3	EA	SILENCER	SR64	 GRY	IVE

Hardware Group No. 01

For use on Door #(s):

113                    123A

Provide each PR door(s) with the following:










QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	661HD	AL	STA
1	EA	REMOVABLE MULLION	KR4023	 SP28	FAL
1	EA	PANIC HARDWARE	CD-24-R-EO	 630	FAL
1	EA	PANIC HARDWARE	CD-24-R-NL-OP	 630	FAL
1	EA	MULLION STORAGE KIT	MT54	689	VON
2	EA	EXTENDED CYLINDER	1E72	626	BES
2	EA	HIGH SECURITY CYLINDER	1E7K4-32-S2	626	BES
4	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
2	EA	90 DEG OFFSET PULL	8190EZHD 12" STD	 626	IVE
2	EA	H-SEC SURFACE CLOSER	4211 HCUSH	 689	LCN
2	EA	PERIMETER GASKETING	BY ALUMINUM DOOR MANUFACTURER		
2	EA	DOOR SWEEP	8197AA	 AA	ZER
1	EA	THRESHOLD	545A	 A	ZER

Hardware Group No. 02

For use on Door #(s):

101                    121B











Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONTINUOUS HINGE	661HD	AL	STA
1	EA	PANIC HARDWARE	CD-25-R-NL	 630	FAL
1	EA	EXTENDED CYLINDER	1E72	626	BES
1	EA	HIGH SECURITY CYLINDER	1E7K4-32-S2	626	BES
2	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
1	EA	H-SEC SURFACE CLOSER	4211 HCUSH	 689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS	 605	IVE
1	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS	 630	IVE
2	EA	EDGE GUARD	7302 STD	 630	IVE
1	EA	RAIN DRIP	142AA	 AA	ZER
1	EA	GASKETING	429AA	 AA	ZER
1	EA	DOOR SWEEP	8197AA	 AA	ZER
1	EA	THRESHOLD	545A	 A	ZER

Hardware Group No. 03

For use on Door #(s):  
 121F







Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONTINUOUS HINGE	661HD		AL	STA
1	EA	REMOVABLE MULLION	KR4023		SP28	FAL
1	EA	PANIC HARDWARE	CD-24-R-EO		630	FAL
1	EA	PANIC HARDWARE	CD-24-R-NL-OP		630	FAL
1	EA	MULLION STORAGE KIT	MT54		689	VON
2	EA	EXTENDED CYLINDER	1E72		626	BES
2	EA	HIGH SECURITY CYLINDER	1E7K4-32-S2		626	BES
4	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM		626	BES
2	EA	90 DEG OFFSET PULL	8190EZHD 12" STD		626	IVE
2	EA	H-SEC SURFACE CLOSER	4211 HCUSH		689	LCN
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	488SBK PSA		BK	ZER
2	EA	MEETING STILE	8217SBK PSA		BK	ZER
2	EA	DOOR SWEEP	8197AA		AA	ZER
1	EA	THRESHOLD	545A		A	ZER

Hardware Group No. 04

For use on Door #(s):  
 126





Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	FBB179 4.5" x 4.5"		626	STA
1	EA	PRIVACY LOCK	L9040 03A 09-544 L283-724		626	SCH
1	EA	SURFACE CLOSER	4111 RW/62A		689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS		605	IVE
1	EA	MOP PLATE	8402 4" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 05

For use on Door #(s):  
 102








Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONTINUOUS HINGE	661HD		AL	STA
1	EA	OFFICE LOCK	MA521BDC SN		626	FAL
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM		626	BES
1	EA	H-SEC SURFACE CLOSER	4510		689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS		605	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	PERIMETER GASKETING	BY ALUMINUM DOOR MANUFACTURER			

Hardware Group No. 06

For use on Door #(s):  
 121D                    121E





Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONTINUOUS HINGE	661HD		AL	STA
1	EA	REMOVABLE MULLION	KR4023		SP28	FAL
2	EA	PANIC HARDWARE	LD-24-R-EO		630	FAL
1	EA	MULLION STORAGE KIT	MT54		689	VON
1	EA	HIGH SECURITY CYLINDER	1E7K4-32-S2		626	BES
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM		626	BES
2	EA	H-SEC SURFACE CLOSER	4211 CUSH		689	LCN
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	MEETING STILE	8217SBK PSA		BK	ZER
2	EA	DOOR SWEEP	8197AA		AA	ZER
1	EA	THRESHOLD	545A		A	ZER

Hardware Group No. 07

For use on Door #(s):  
 119






Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	FBB179 4.5" x 4.5" NRP	626	STA
1	EA	CLASSROOM LOCK	MA561BDC SN	 626	FAL
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
1	EA	H-SEC SURFACE CLOSER	4211 CUSH	 689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS	 605	IVE
3	EA	SILENCER	SR64	 GRY	IVE

Hardware Group No. 07A

For use on Door #(s):  
 118






Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	FBB179 4.5" x 4.5" NRP	626	STA
1	EA	CLASSROOM LOCK	MA561BDC SN	 626	FAL
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
1	EA	OH STOP	90S	 630	GLY
1	EA	SURFACE CLOSER	4111 RW/62A	 689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS	 605	IVE
3	EA	SILENCER	SR64	 GRY	IVE

Hardware Group No. 07B

For use on Door #(s):  
 116B                    117A                    117B





Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	FBB179 4.5" x 4.5"	626	STA
1	EA	CLASSROOM LOCK	MA561BDC SN	 626	FAL
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
1	EA	SURFACE CLOSER	4111 RW/62A	 689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS	 605	IVE
1	EA	WALL STOP	WS406/407CCV	 626	IVE
3	EA	SILENCER	SR64	 GRY	IVE

Hardware Group No. 08

For use on Door #(s):  
 128





Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	FBB179 4.5" x 4.5"	626	STA
1	EA	STOREROOM LOCK	MA581BDC SN	 626	FAL
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS	 605	IVE
1	EA	WALL STOP	WS406/407CCV	 626	IVE
1	EA	GASKETING	488SBK PSA	 BK	ZER

Hardware Group No. 08A

For use on Door #(s):  
 125







Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	FBB179 4.5" x 4.5"	626	STA
1	EA	STOREROOM LOCK	MA581BDC SN	 626	FAL
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
1	EA	OH STOP	90S	 630	GLY
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS	 605	IVE
1	EA	GASKETING	488SBK PSA	 BK	ZER

Hardware Group No. 08B

For use on Door #(s):  
 122                    124A                    124B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	FBB179 4.5" x 4.5" NRP	626	STA
1	EA	CONST LATCHING BOLT	FB51P	 630	IVE
1	EA	DUST PROOF STRIKE	DP2	 626	IVE
1	EA	STOREROOM LOCK	MA581BDC SN	 626	FAL
1	EA	PERMANENT CORE	SFIC BEST - MATCH EXISTING SYSTEM	626	BES
2	EA	OH STOP	90S	 630	GLY
2	EA	KICK PLATE	8400 12" X 1" LDW B-CS	 605	IVE
2	EA	SILENCER	SR64	 GRY	IVE

## SECTION 088000 – GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes glazing for the following applications:
  - 1. Windows.
  - 2. Doors.
  - 3. Exterior storefront framing.
  - 4. Glazed entrances.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

#### 1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

#### 1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Preconstruction adhesion and compatibility test report.
- E. Warranty.

## 1.5 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing labeling is indicated or required, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

## 1.6 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.



- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by Guardian Glass; Sunguard, or a comparable product by one of the following:
1. Vitro Architectural Glass (formerly PPG Glass).
  2. Pilkington North America.

## 2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Security Glazing: Childgard-2118 to meet ASTM F1233 Class 1.4 Forced Entry Resistance.
- D. Privacy Glazing: McGrory Glass

## 2.4 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by Guardian Glass; Solar Control Low-E Glass, in locations indicated on drawings.
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Sealing System: Dual seal with manufacturer's standard primary and secondary.
  2. Spacer: Aluminum with, color as selected by Architect.

## 2.5 MONOLITHIC-GLASS TYPES

- A. Glass Type C: Clear fully tempered float glass
1. Thickness: 1/4 inch (6.0 mm).

## 2.6 INSULATING-GLASS TYPES

- A. Glass Type A: Low-E, clear insulating glass;

1. Overall Unit Thickness: 1 inch (25 mm)
2. Thickness of Each Glass Lite: 1/4" Inch
3. Visible Light Transmittance: 62% minimum
4. Winter Nighttime U-Factor: .28 maximum
5. Summer Daytime U-Factor: .27 maximum
6. Solar Heat Gain Coefficient: .27 maximum
7. UV Transmittance 6% maximum
8. Shading Coefficient: .31
9. Composition: 1/4" Guardian SNX 62/27 #2 – 1/2" air space - 1/4" clear float

B. Glass Type B: Low-E, clear insulating glass with translucent privacy interlayer treatment

1. Overall Unit Thickness: 1 inch (25 mm)
2. Thickness of Each Glass Lite: 1/4" Inch
3. Visible Light Transmittance: 62% minimum
4. Winter Nighttime U-Factor: .28 maximum
5. Summer Daytime U-Factor: .27 maximum
6. Solar Heat Gain Coefficient: .27 maximum
7. UV Transmittance 6% maximum
8. Shading Coefficient: .31
9. Composition: 1/4" Guardian SNX 62/27 #2 w/ acid etch, opacity to be determined by architect – 1/2" air space - 1/4" clear float

C. Glass Type D: Security Glazing – Childgard laminated insulating glass

1. Overall Unit Thickness: 1 1/8 inch
2. Composition: 1/4" Guardian SNX 62/27 #2 w/ acid etch, opacity to be determined by architect – 3/8" air space - 9/16" Childgard-2118 Security Glazing

## 2.7 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

## 2.8 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: As selected by Department from manufacturer's full range.

## 2.9 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
  1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.10 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

## PART 3 - EXECUTION

### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

## SECTION 099216 NON-STRUCTURAL METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
  - 1. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

#### 1.2 SUBMITTALS

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

#### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### PART 2 - PRODUCTS

#### 2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Basis of Design product is Dietrich UltraSTEEL® Framing; Dietrich Metal Framing Company, Pittsburgh, PA 15219; [www.dietrichmetalframing.com](http://www.dietrichmetalframing.com).
- C. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

#### 2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- B. Flat Hangers: Steel sheet, 1 by 3/16 inch (25.4 by 4.76 mm) by length indicated.

- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.
  - 1. Depth: 2-1/2 inches (64 mm)
- D. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
  - 2. Steel Studs: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm)
    - b. Depth: As indicated on Partition Schedule
- E. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

## 2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).
- B. Slip-Type Head Joints: Where indicated, provide the following:
  - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
- C. Firestop Track: As specified in Division 07 Section "Fire-Resistive Joint Systems."
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).
- E. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
  - 1. Depth: 1-1/2 inches (38.1 mm)
  - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.
- F. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
  - 1. Depth: 3/4 inch (19.1 mm)
  - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.



## 2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
  - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
  - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

### 3.2 INSTALLING SUSPENSION SYSTEMS

- A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- B. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Do not attach hangers to steel roof deck.
  - 4. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

### 3.3 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- C. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Materials shall comply with the 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."

#### 2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content of gypsum panel not less than 90 percent.

#### 2.3 INTERIOR GYPSUM BOARD

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

1. CertainTeed Corporation.
2. National Gypsum Company.
3. United States Gypsum Company.

- B. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M.

1. Basis of Design: CertainTeed Gypsum; Saint-Gobain; Extreme Abuse Board.
2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
- B. Aluminum Trim: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

## 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

## 2.6 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

### 3.2 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these

locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- D. Install 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.
  - 1. Control Joints: Install control joints at locations indicated on drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- E. Prefill open joints and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
- H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Resilient base.
  - 2. Resilient molding accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Install resilient products after other finishing operations, including painting, have been completed.

#### 1.5 EXTRA MATERIALS

- A. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
  - 1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof, of each different composition and color of resilient wall base installed.

## PART 2 - PRODUCTS

### 2.1 THERMOSET WALL BASE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Johnsonite; a Tarkett company; Baseworks, or a comparable product by one of the following:
  - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc; BurkeBase TS.
  - 2. Roppe Corporation, USA; Pinnacle.
  - 3. Allstate Rubber; Wall Base TS.
- B. Resilient Base Standard: ASTM F 1861.
  - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
  - 2. Manufacturing Method: Group I (solid, homogeneous)
  - 3. Style: Cove (base with toe) in areas with resilient floor coverings or no floor covering.
- C. Minimum Thickness: 0.125 inch (3.2 mm)
- D. Height: 4 inches (102 mm).
- E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors and Patterns: As selected by Architect from manufacturer's standard colors.

### RESILIENT MOLDING ACCESSORIES:

- A. Manufacturers: Subject to compliance with requirements, provide products from the same manufacturer as the rubber base above.
- B. Description: provide molding accessories and flooring transitions for applications as indicated in Drawings.
- C. Material: Rubber.
- E. Colors and Patterns: As selected by Architect from full range of standard colors.

## 2.2 INSTALLATION MATERIALS

- A. Trowelable 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.
  - 1. Adhesives shall have a VOC content of 50 g/L or less and 60 g/L or less for rubber stair treads.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Rubber Accessories: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
  - 4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.



### 3.2 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 practicable 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. Preformed Corners: Install preformed corners before installing straight pieces.

### 3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
  - 1. Apply coat(s) as recommended by manufacturer.
- C. Cover resilient products subject to wear and foot traffic until Substantial Completion

END OF SECTION 096513

## SECTION 096519 - RESILIENT TILE FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Bio-based floor tile.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full-size units for each color and pattern specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, moisture mitigation systems, primers, including leveling and patching compounds, and adhesives.
- B. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

#### 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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

- B. Flooring products shall comply with the 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."

## 2.2 BIOBASED FLOOR TILE

- A. Basis of Design Product: Subject to compliance with requirements provide A Marmoleum MCT Tile by Forbo Flooring Systems.
  - 1. Wearing Surface: Smooth.
  - 2. Thickness: 2 mm.
  - 3. Size: 33 cm X 33 cm
  - 4. Polyester backing.
  - 5. BOD Product: Marmoleum MCT Tile by Forbo Flooring Systems.
  - 6. Location and Pattern: as indicated on Drawings.
  - 7. Colors: Four colors to be selected from manufacturer's standard range.
    - a. Office:
      - 1) RT 1 – MCT 3629 Frosty Grey (Field Tile Color)
      - 2) RT 2 – MCT 3277 Grape (Accent Tile Color)
      - 3) RT 3 – MCT 3251 Lemon Zest (Accent Tile Color)
      - 4) RT 4 – MCT 3275 Chinchilla (Accent Tile Color)

## 2.3 FLOOR LEVELING MATERIALS

- A. General: Use products selected for substrate conditions encountered, selected from those specified in this Article unless otherwise indicated or recommended by resilient floor tile manufacturer.
- B. Trowelable Leveling and Patching Compound: Hydraulic-cement-based subfloor smoothing compound formulated for repairs up to 1/4 inch thick, and that can be feathered at edges.
  - 1. Basis-of-Design Product: Ardex, Inc.; Feather Finish.
- C. Self-Leveling Topping and Underlayment: Cement-based product that can be applied in uniform thicknesses above 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Basis-of-Design Product: Ardex, Inc.; Ardit SD-T.
  - 2. Water: Potable and at a temperature of not more than 70 deg F.
  - 3. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

## 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives 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."
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.
- D. Cleaner and Polish for PVC-Free Composition Tile: Provide cleaners and protective liquid floor polish products as recommended by manufacturer.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing.
  4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
    - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

#### 3.2 FLOOR TILE INSTALLATION

- A. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

- B. Comply with manufacturer's written instructions for installing floor tile.
- C. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis and in pattern indicated.
- D. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction and in pattern of colors and sizes indicated.
- E. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- F. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- H. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- I. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply as recommended by manufacturer.
- C. Cover floor tile until Substantial Completion.

END OF SECTION 096519

## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Concrete masonry units (CMUs).
  - 2. Steel and iron.
  - 3. Galvanized metal.
  - 4. Wood.
  - 5. Gypsum board.
- B. Related Requirements:
  - 1. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Environmental Responsibility Submittals:
  - 1. Laboratory Test Reports: For paints and coatings, documentation indicating that they meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples: For each type of paint system and in each color and gloss of topcoat.

#### 1.3 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. (3.8 L) of each material and color applied.

#### 1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

- a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
  - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the product listed in the paint schedules The Sherwin-Williams Company; [www.sherwin-williams.com](http://www.sherwin-williams.com); or an approved equal product by one of the following manufacturers:
1. Benjamin Moore & Company.
  2. PPG Industries, Inc.

### 2.2 PAINT, GENERAL

- A. 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.
- B. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Colors: As selected by Architect from manufacturer's full range. Architect reserves right to select multiple colors, as per drawings. Locations:
1. Color 1: Neutral light color on existing and new CMU walls in Vestibule
  2. Color 2: Neutral medium color on existing and new CMU walls in Office
  3. Color 3: To be selected, for painted wood window sills

## 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 CMUs): 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.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
- B. 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.
- C. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view on exterior:
    - a. Panelboards.
    - b. Piping.
    - c. Pipe hangers and supports.
    - d. Conduit.
  2. Paint the following work where exposed in equipment rooms:
    - a. Panelboards.
    - b. Uninsulated piping.
    - c. Pipe hangers and supports.



- d. Metal conduit.
  - e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
3. Paint the following work where exposed in occupied spaces:
- 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.
  - h. Other items as directed by Architect.
4. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
- 1. Waterborne Dryfall System:
    - a. Finish: Two coats Low VOC Waterborne Acrylic Dryfall, Flat B42-W00081
- B. Steel and Galvanized Metal Substrates, New and Existing:
- 1. Urethane system:
    - a. Primer: ProIndustrial Pro-Cryl Universal Primer
      - 1) Where corrosion is evident, provide KemBond Alkyd Primer
    - b. Finish: Two coats ProIndustrial WB Alkyd Urethane Enamel, B53 series, semi-gloss
- C. Exposed Structural Steel Substrates, New and Existing:
- 1. Alkyd System
    - a. Primer: Recoatable Epoxy Primer (where required over existing steel and new steel factory primer)
    - b. Finish: Two coats ProIndustrial WB Alkyd Urethane Enamel, B53 series, semi-gloss
- D. CMU Substrates, New:
- 1. Institutional Low-Odor/VOC Latex System:
    - a. Filler: PrepRite Block Filler, 50 g/l
    - b. 1st Coat: ProMar 200 0 VOC eggshell.
    - c. 2nd Coat: ProMar 200 0 VOC eggshell.
- E. Masonry Substrates, Existing (Previously painted):
- 1. Water-Based Epoxy System
    - a. Primer: Extreme Bond Primer
    - b. Finish: Two coats ProIndustrial Pre-Catalyzed Water-Based Epoxy, eggshell

- F. Wood Substrates:
  - 1. Institutional Low-Odor/VOC Latex System:
    - a. Primer: ProMar 200 0 VOC Primer.
    - b. 1st coat: ProMar 200 0 VOC semi-gloss.
    - c. 2nd coat: ProMar 200 VOC semi-gloss.
    - d. 2nd coat: ProMar 200 0 VOC eggshell.
- G. Gypsum Board Substrates, Ceilings and Soffits:
  - 1. Institutional Low-Odor/VOC Latex System:
    - a. Primer: ProMar 200 0 VOC Primer
    - b. 1st coat: ProMar 200 0 VOC 200 flat.
    - c. 2nd coat: ProMar 200 0 VOC flat
- H. Insulation-Covering Substrates: Including pipe and duct coverings.
  - 1. Institutional Low-Odor/VOC Latex System:
    - a. Prime Coat: ProMar 200 Zero VOC Primer.
    - b. 1st Coat: ProMar 200 Zero VOC flat.
    - c. 2nd Coat: ProMar 200 Zero VOC flat.

END OF SECTION 099123

## SECTION 100610 - EXTERIOR SIGNAGE

### 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. Philadelphia Parks and Recreation Signage Standards Manual, latest version.

#### 1.2 REQUIRED QUALIFICATIONS SUBMITTALS

- A. The awarded Fabricator will have provided their qualifications at or prior to the time of Bid. The Fabricator is required to submit as part of the submittal process additional qualifications for any subcontractors, including but not limited to, installers, electrician, specialty sub-contractor and/or project managers not included or accepted with the bid award of the project. The Owner reserves the right to accept or reject any sub-contractor and/or project manager submitted for review. Qualifications should include: a minimum of 5-10 years relevant experience and shall provide information that illustrates the following:

- 1. Firm/Personnel qualifications.
- 2. Projects of similar size and complexity.
- 3. Demonstration of high quality craftsmanship.
- 4. Project management team and experience.

- B. Regional Vendors:

- 1. Urban Sign and Crane  
527 E. Chestnut Avenue  
Voorhees, NJ 08360  
856.691.8388  
[www.urbansigncompany.com](http://www.urbansigncompany.com)
- 2. M.S. Signs, Inc.  
6 Morris Street  
Paterson, NJ 07501  
973.569.1111  
[www.mssign.com](http://www.mssign.com)
- 3. L&H Sign Company  
425 North 3<sup>rd</sup> Street  
Reading, PA 19601  
[www.lhsigns.com](http://www.lhsigns.com)
- 4. Compass Sign Co LLC

1505 Ford Road  
Bensalem, PA 19020  
215.639.677  
www.compass-sign.net

5. Allied Environmental Signage  
69 Megill Road  
Farmingdale, NJ 07727  
732.751.1818  
[www.allied-signs.com](http://www.allied-signs.com)
6. Or proposed qualified manufacturer, qualifications to be submitted to the owner for approval during bid process.

### 1.3 ACTION SUBMITTALS

#### A. SHOP DRAWINGS

Submit one (1) electronic set of shop drawings as outlined below: Include plans, elevations, sections and large-scale details of sign construction, wording, and lettering layout. Show anchorages and accessory items. Provide graphic layouts of each individual sign face and message for each sign location. Show fabrication and installation details, including all sign components such as: extrusions, brackets, bracing, hardware, internal framing, etc. Alphabet of each type style required by the contract documents, including upper and lowercase, with numerals, punctuation and accents. Shop drawings MUST include all field verified conditions and dimensions. Show installation and mounting heights.

#### B. PRODUCT SPECS AND WARRANTY INFORMATION

Provide documentation outlining all project warranties, including both product and manufacturing. Submit cut sheets for all specified products.

#### C. SAMPLES (If required by Owner)

Samples shall be clearly labeled on the back (where possible), designating item number, name of manufacturer, sign type and location. Fabricator shall submit a minimum of two (2) samples of each color and finish applied on each material type as indicated in the drawing package. Samples should represent the final finish of each element and will be used as control samples for production approval. Samples should represent extreme variations in color and texture that might occur during fabrication. Please submit the following samples as specified in the drawing package, list project specific submittal requirements.

#### D. COLOR SAMPLES

Color sample(s) for each specified color, process and finish. Color submittal(s) shall be submitted on each relevant substrate specified.

#### E. MATERIAL SAMPLES

Material samples of each specified Material (M1, M2 etc.) in each color and finish specified. Submit manufacturer's standard color palette where required for color and finish selection.

#### F. CHPL SAMPLES

Custom High Pressure Laminate (CHPL) manufacturer must supply project-specific electronic PDF proofs for content approval and minimum 8" x 10" x .060" actual material lab samples for color and finish approval from production-ready digital art work and specifications as provided by Designer. 154 Philadelphia Parks and Recreation I SIGNAGE STANDARD MANUAL

#### G. PAPER TEMPLATES

Templates should be fully assembled or have complete registration marks for assembly. Fabricator shall provide for Designer approval, full-size paper templates for review and approval in the field of the following sign types:

PID.1, PLY.1 (FOR 2-5) AND PLY.2 (FOR 5-12), BUL1.C, AND RUL.2.

H. SIGN SAMPLES

A. Sign Contractor shall construct the following sign samples/mock-ups:

1. PLY.1 (only required by Fabricator on initial fabrication contract for this program)

1.4 REVIEW PROCESS

- A. Each reviewing party, i.e. Designer, Owner, Architect, etc. will each require a minimum of 10 business days to review all submittals. The process and sequence of submittal and review shall be discussed and agreed to during the project kickoff meeting. Designer reserves the right to reject any submittal (shop drawing, sample, etc.) that does not satisfy the requirements as outlined in this document including but not limited to: field conditions, construction, finish or color requirements. Submit additional drawings/ samples as required to obtain final approval.

1.5 WORK INCLUDED

- A. Site verification, fabrication, and delivery-of all sign types and quantities indicated in the final approved locations.
- B. Installation of signs may be completed by the Fabricator or the General Contractor. Fabricator to verify the sign quantities from the Copy List and Sign Location Plans and if discrepancies exist, notify the Designer of any such discrepancies.
- C. Work shall include all support structures and fasteners required for installation. Work shall include all design engineering needed to produce the project to comply with all applicable municipal, state and federal code, and structural soundness. Fabricator to provide all services, subcontractors, labor, materials and equipment needed to complete the work described in this design drawings and specifications document.  
It is the Fabricator's responsibility to have all submittal drawings signed and sealed by a Structural Engineer.
- D. Fabricator shall visit site before construction begins and inspect each proposed sign location. Any issues or concerns shall be communicated to the Designer in writing within twenty-four (24) hours. Upon award of the bid, the selected Fabricator shall arrange a meeting with the Designer to review the scope of work.
- E. Fabricator will be responsible for providing the Designer and Owner a project schedule that outlines durations for all work including delivery dates for submittals and Designer and Owner review time. Sign Contractor shall update and reissue the schedule throughout the project and communicate all changes/impacts on the schedule to Designer and Owner.
- F. Prior to installation, the Fabricator shall conduct a pre-install walk through with the Designer and Owner to address any potential issues/questions.
- G. At the substantial completion of the project the Fabricator shall perform a walk-through with the Designer and Owner to inspect the installation and create a punch list of all unsatisfactory items. Fabricator is required to complete all punch list items within 3-4 weeks of receipt of punch list.

1.6 WORK QUALITY

- A. All work to be done in a professional manner and to the highest trade standards. Fabricator is responsible for ensuring the quality standards above for all related professional and trade

- subcontracted work including: general carpentry, masonry, electrical, landscaping, or utilities required for the installation of all sign types as described, unless otherwise agreed to by Owner.
- B. All subcontracted work must meet the general accepted professional standards.

## 1.7 REFERENCE STANDARDS

- A. The following materials reference standards will apply to the work materials (use most current version of reference standards):
1. ASTM A36 Structural Steel
  2. ASTM A123 Zinc (Hot Galvanized) coatings on products fabricated from rod, pressed, and forged steel shape, plates and bars.
  3. ASTM B221 Aluminum-alloy extruded bars, rods, wire, shapes and tubes.
  4. ASTM D822 Light and Water exposure apparatus (Carbon-arc type) for testing paint, varnish, lacquer, and related products.
  5. ASTM E84 Surface-burning characteristics of building materials, lacquer and related products.
  6. AWI Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute.
  7. CDA Copper Development Association, Inc.
  8. FS L-P-391 Plastic sheet, rods and tubing, rigid, cast materials
  9. FS L-P-387 Plastic sheet, laminated, thermosetting
  10. PS-1 Construction and industrial plywood
  11. PEI Porcelain Enamel Institute
  12. TM 8135 QQ-B-613 (Fed Spec) Brass, Muntz 280
  13. UL-943 Fluorescent lamp ballasts quality
  14. ICC A117.1 – 2009 Accessible and Usable Buildings and Facilities

## 1.8 WARRANTIES

- A. Warrant all products (including, but not limited to: materials, hardware, and finishes) against any and all defects based on manufacturers' supplied warranties from date of installation. All manufacturer warranties should be submitted to the Designer and Owner for review.
1. Vinyl die-cut letters: warranted against delimitation from substrate.
  2. Paint finishes: warranted against fading or chalking, corrosion developing beneath paint surfaces of the support systems (except for obvious vandalism or other external damage to the paint surfaces).
  3. Corrosion of the fastenings.
  4. The signs not remaining true and plumb on their supports during normal wear.
  5. Fading of the colors when matched against a sample of the original color and material.
  6. Discoloration of metal finishes.
  7. Adhesives, e.g. tape and epoxy
  8. Paneling not remaining true and plumb on their supports during normal wear.
- B. The Fabricator shall correct any and all material and/ or workmanship defects which may appear during the warranty period by restoring defective work to the standard of the contract documents at no cost to the Owner and to the Owner's satisfaction. Corrections include but are not limited to disfiguring of any surface due to chalking, rusting, bubbling, or other disintegration of the sign face or of the messages or of the edge finish of the sign inserts or panel.

- C. Manufacturer warrants that under normal wear and use the installation and signposts will not crack or fail for a period of ten (10) years from the date of substantial completion.
- D. Installer shall provide labor and material warranty for a period of one (1) full year from the date of substantial completion.

#### 1.9 CHPL PRODUCT WARRANTIES

- A. Manufacturer warrants that under normal wear and use the workmanship and materials used in the CHPL product purchased from the Manufacturer will meet the standards set forth on the applicable specification materials and that the product will not delaminate, peel, blister, crack or fade for a period ten (10) full years from the date of purchase.
  - 1. In the event that the product does not perform as warranted:
  - 2. Manufacturer shall be allowed to conduct an on-site inspection and investigation, or be provided digital images of defects
  - 3. Manufacturer shall work directly with the end-user to resolve any warranty matter,
  - 4. The sole remedy will be the repair or replacement of the defective product at the sole discretion of the Manufacturer, and/ or
  - 5. The repair or replacement by Manufacturer shall be limited to the re-manufacture and shipment of the replacement or repaired product to the site of the end-user's product.
- B. This warranty only applies to the manufacture and material used in the manufacture of the product. Manufacturer shall not be liable for any other costs, including but not limited to installation, labor or other costs or expenses. Any repair or replacement shall be warranted for a period up to the remaining life of the original warranty. Further the repair or replacement costs incurred by Manufacturer shall not exceed the purchase price paid for the product.

#### 1.10 QUALITY ASSURANCE

- A. Work done and materials furnished shall meet the highest industry standards in every respect and, unless otherwise specified, materials and equipment shall be new and of the latest design.
- B. The Design Intent Package should provide everything necessary for a complete contract.
- C. In the event of conflict or omission, the Fabricator shall consult the Designer for resolution. All clarifications are to be made in writing in the form of an RFI from the Fabricator to the Designer.
- D. Use only personnel thoroughly skilled and experienced with the products and method for fabrication and installation of signage specified.
- E. The Owner shall reserve the right to reject any shop drawings, samples or other submittals, as well as any finished product or installation, that cannot meet the standard of quality established. Any such decision will be considered final and not subject to recourse.
- F. Materials and hardware not specified, but necessary to the complete functioning of the sign, shall conform to the quality level established.
- G. Substitutions of items specifically indicated in this specifications package that serve the same function with equal performance will be considered upon submission of substitution. SEE DIV 1.

### PART 2 - MATERIALS AND PRODUCTS

#### 2.1 ALUMINIUM

- A. Aluminum shall be of best commercial quality and the various forms shall be straight and true. There shall be no scratches, scars or buckles. Size thickness and finish of aluminum shall be per NAAMM "Metal Finishes Manual". Comply with the following industry standards.
- B. Aluminum sheets shall conform to ASTM B209 6061-T6
- C. Aluminum extrusions shall conform to ASTM B241 6063 T6. Wall thickness shall be a minimum of 1/8" thick unless otherwise shown.
- D. Brushed Finishes-Brush with abrasive of increasing grit# in a linear directional pattern.
- E. Final surface shall have visible grain pattern to match sample approved by Designer. Spray with clear protective finish.
- F. Polished Finish-Brush with abrasive of increasing grit #. Buff to a mirror finish with no visible grain. Match sample approved by Designer. Spray with clear protective finish.
- G. Non-Directional Finish-Brush with abrasive mounted in a random orbital sander. Match sample approved by Designer. Spray with clear protective finish.

## 2.2 STAINLESS STEEL

- A. Structural Stainless steel shapes to be rolled or laser fused, as manufactured by Stainless Structural, LLC. (936-538- 7600, [www.stainless-structurals.com](http://www.stainless-structurals.com))
- B. Chromium stainless steel sheet. Use type 304 or type 316 stainless steel with 16% chromium and 10% nickel.
- C. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness. Stainless Steel Plate, Sheet and Strip: Provide stainless steel plate, sheet, or strip, AISI Type 302, complying with requirements of ASTM A 167.
- D. Stainless Steel Finishes: Finish designations prefixed by "AISI" conform to the system established by the American Iron and Steel Institute for designating finishes.
- E. Finish: Bead blasted & Pickled.

## 2.3 CUSTOM HIGH PRESSURE LAMINATE

- A. Provide Custom High pressure laminate as manufacturer by iZone or an approved equal.
- B. Custom High Pressure Laminate material composed of required layers of phenolic resin impregnated brown kraft filler paper to produce specified thicknesses, surfaced by a layers of melamine overlay, graphics imaged on saturation grade paper with UV resistant pigment based process color inks, and with an optically clear UV overlay that will resist no less that 99% of all sunlight and UV rays, as well as provide a graffiti resistant surface that allows for removal with standard cleaners.
- C. Layers of material are to be assembled, and heat/ pressure consolidated at approximately 1200 PSI at temperatures exceeding 275° Fahrenheit at manufacturer's prescribed time frames.



- D. All manufacturing processes of printing, pressing, machining, finishing and crating to be accomplished within a single standalone manufacturing facility to ensure consistent quality control and providing standard product delivery times of three weeks.

#### 2.4 WOOD

- A. #1 grade black locust lumber. Sustainably harvested. Eased edges. Apply a UV clear coat to enhance the wood grain and provide additional protection.

#### 2.5 REFLECTIVE GRAPHICS

- A. Provide 3M Scotchlite enclosed lens reflective sheeting or approved equal.

#### 2.6 CONCRETE

- A. All concrete footers are to be poured in place.
- B. All concrete footers are to be poured from thoroughly mixed and agitated concrete in order prevent unreasonable voids in the finished casting.
- C. Concrete to meet specified "PSI Test" for strength: 3,500 psi minimum. Concrete to meet specified "Slump test" before pouring footing. All footings to extend past the frost line.
- D. Any footers or posts for signs will be placed in wet concrete and allowed to fully cure in place before any signage is attached or mounted to it in any way. All exposed faces of concrete shall receive a finish to match existing, adjacent surfaces.

#### 2.7 VHB FOAM TAPES

- A. Provide 3M Scotch VHB 4930
- B. Adhesive shall be Acrylic VHB
- C. Carrier shall be closed cell foam

#### 2.8 ACCESSORIES ANCHORS AND FASTENINGS

- A. Provide anchors and fasteners required to secure work in place. Do not expose fastenings on surface of sign panels unless specifically noted otherwise. Do not deform, distort or discolor sign face surfaces by attachment of concealed fastenings.
- B. All fastenings shall be non-corrosive and resistant to oxidation or other corrosive action, of the same composition completely through their cross sections, particularly when used below grade. Use highest quality stainless steel hardware and fasteners.
- C. Anchors, inserts or fasteners shall be compatible with sign materials, shall not result in galvanic action or chemical interaction of adhesives and shall have demonstrable and sufficient strength for intended use.

- D. Steel anchors and fastenings for exterior use shall be galvanized in accordance with ASTM A153.
- E. Fabricate and install signs with fastenings to withstand all actions imposed by use; 30 psf wind perpendicular to surfaces, water, ice, snow loads and similar forces.
- F. Anchor bolts in concrete shall be cast in place. Fabricator shall furnish instructions for the setting of anchors and bearing plates. Fabricator shall ascertain that the items are properly set during the process of the work.
- G. Secure work with fastenings of same color and finish as the components they secure where they are exposed to view, unless noted otherwise. All exposed fasteners must be vandal resistant and have vandal-proof "spanner" type slots to be removed only with a special driver head.

### PART 3 - EXECUTION

#### 3.1 PROTECTION AND STORAGE

- A. Fabricator is responsible for storage of signs and assemblies and protection from damage at the shop, in transit and until erected in place, complete, inspected and accepted by Owner.
- B. Fabricator is responsible for the replacement pilferage both prior to and until inspection and acceptance of installation by the Owner.

#### 3.2 INSPECTION

- A. All production materials, color samples and paints, fabricated or partially fabricated items shall be available for inspection, on-site or in the shop, by the Owner or Designer during the manufacturing process and until final delivery, installation and acceptance, to determine compliance with the requirements of these specifications. Shop inspection approvals do not guarantee final acceptance of installed work.

#### 3.2 INSTALLATION

- A. Install sign units and components with concealed fasteners unless otherwise shown. Refer to drawings for general method of installation. Verify each surface in field to determine appropriate mounting hardware. Fabricator is responsible for determining where below ground or in-wall structural tie-ins may be required. All elements should be installed true and plumb in accordance with the design intent of this document.  
Fabricator is responsible for determining the location of underground structures and utilities on ground-mounted signs. Any conflicts should be brought to the attention of the Owner and Designer.
- B. Sign location drawings show approximate locations of signs. Fabricator, Designer and Owner shall conduct a pre-install mark out walk through to confirm all locations and identify areas of conflict.

#### 3.3 REGULATORY REQUIREMENTS

- A. All installation work shall comply with applicable municipal, state and federal codes, sign ordinances and ADA guidelines for handicapped and fire/life safety signing.
- B. All OSHA safety requirements will be implemented during fabrication and installation as needed or required to comply with safety regulations.

- C. All field/site work shall be conducted in compliance with the Owner/Construction Manager's requirements/ regulations for the site, particularly areas open and accessible to the public. Work area protection shall be required as needed and all site-specific rules should be reviewed and outlined during the project kick-off meeting.

#### 3.4 CLEAN UP

- A. Daily and upon completion of installation remove all waste, dirt, wrappings and excess materials, tools and equipment, and thoroughly clean all surfaces to the satisfaction of the Owner.

#### 3.5 REORDERING

- A. Reordering all items specified in this package shall be available to the Owner in additional quantities for a period of 10 years after completion of all work called for in this specification.

END OF SECTION 100610

## SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Dimensional characters.
    - a. Cutout dimensional characters.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, and layout for each sign.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 DIMENSIONAL CHARACTERS

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide products by Gemini Incorporated; or a comparable product by one of the following:

- a. ACE Sign Systems, Inc.
- b. APCO Graphics, Inc.
- c. ASI Sign Systems, Inc.
2. Character Material: Sheet or plate aluminum.
3. Character Height: As indicated.
4. Thickness: As indicated
5. Finishes:
  - a. Aluminum Finish: Baked-Enamel or Powder-Coat Finish: Manufacturer's standard process, in custom color if required to match Architect's sample.
  - b. Mounting: Projecting studs. Stand off canopy as indicated.

## 2.2 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
  3. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
  4. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

## 2.3 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  4. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
  5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF DIMENSIONAL CHARACTERS

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
  - 1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

## SECTION 101423 - PANEL SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Panel signs.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Environmental Responsibility Submittals:

1. Product Data: For adhesives, documentation including printed statement of VOC content.

C. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign.

D. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.
- C. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

### 2.2 PANEL SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. APCO Graphics, Inc.
  - 2. Bunting Graphics, Inc.
  - 3. Mohawk Sign Systems.
  - 4. Nelson-Harkins Industries.
- B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:
  - 1. Aluminum Sheet: 0.050 inch (1.27 mm) thick.
  - 2. Laminated, Aluminum Faced Sheet: 0.020-inch- (0.51-mm-) thick aluminum sheet laminated to each side of 0.197-inch- (5.0-mm-) thick, acrylic backing with painted edges.
  - 3. Acrylic Sheet: 0.060 inch (1.52 mm) thick.
  - 4. Edge Condition: Square cut.
  - 5. Corner Condition: Square.
  - 6. Mounting: Unframed.
    - a. Wall mounted with concealed anchors, magnetic tape or two-face tape.
    - b. Manufacturer's standard anchors for substrates encountered.
  - 7. Color: As selected from manufacturer's full range of available colors.
  - 8. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.
- C. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
  - 1. Panel Material: Opaque acrylic sheet or clear acrylic sheet with opaque color coating, subsurface applied.
  - 2. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).
- D. Exterior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirement
  - 1. Acrylic Sheet: 0.060 inch (1.52 mm) thick.
  - 2. Edge Condition: Square cut
  - 3. Corner Condition: Square



4. Mounting: Unframed
  - a. Wall mounted
  - b. Manufacturer's standard noncorroding anchors for substrates encountered
5. Color: As selected by Architect from manufacturer's full range

## 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. Furnish inserts, as required, to be set into concrete or masonry work.
  3. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated
- B. Adhesive: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

## 2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
  5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

## 2.5 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for three years for application intended.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
  5. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
  2. Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.
  3. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
  4. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
  5. Shim Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
  6. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
  7. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101423

## SECTION 116800 - PLAY 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 freestanding and composite structure playground equipment.
- B. Related Sections:
  - 1. Section 321816.13 "Playground Protective Surfacing" for protective surfacing under and around playground equipment.

#### 1.3 DEFINITIONS

- A. Fall Height: According to ASTM F 1487, "the vertical distance between a designated play surface and the protective surfacing beneath it."
- B. Critical Height: Standard measure of shock attenuation. According to CPSC No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."
- C. HDPE: High-density polyethylene.
- D. IPEMA: International Play Equipment Manufacturers Association.
- E. LLDPE: Linear low-density polyethylene.
- F. MDPE: Medium-density polyethylene.
- G. Use Zone: According to ASTM F 1487, the "area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of playground equipment and structure indicated.
  - 1. Manufacturer's color charts.
  - 2. Include similar Samples of playground equipment and accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Extent of surface systems and use zones for equipment.
  - 2. Critical heights for playground surfaces and fall heights for equipment.
- B. Qualification Data: For qualified Installer manufacturer, and testing agency.
- C. Product Certificates: For each type of playground equipment, from manufacturer.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For playground equipment and finishes to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm whose playground equipment components have been certified by IPEMA's third-party product certification service.
- B. Installer Qualifications: An employer of workers approved by manufacturer.
- C. Safety Standards: Provide playground equipment complying with or exceeding requirements in ASTM F 1487 and CPSC No. 325.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground equipment that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PLAY EQUIPMENT

- A. Play Equipment: Subject to compliance with requirements, provide products by Landscape Structures, 601 7<sup>th</sup> Street South, Delano, MN 55328, (888) 438-6574, [www.info@playsi.com](http://www.info@playsi.com), or approved equal. Local representative: General Recreation, Andy Cush, [andy@gen-rec.com](mailto:andy@gen-rec.com).
- B. Products and Colors as per quote no: 11734353-01-01
  - 1. 2-5 Age Equipment:
    - a. Custom Weevos 3 Arch Mainstructure with the following components, Bridges 164178A, 173575A, Climbers 173573A, Stainless steel slide CP000433A, Motion 173582A, 164173A, Signs 182503A.
  - 2. 5-12 Play Equipment:
    - a. Custom PlayBooster Netplex 7 post, no roof 193168A and Skyport Climber 193175A with Bridges 184490C, 193173C, Motion 193174A, Overhead 193170A, Posts 111404F, E, O and N, Stainless steel slide 185527A. with Belt, Bucket and Molded Bucket Swings
  - 3. Freestanding Play
    - a. Swing CP001118, CP001117, CP006430
    - b. Bouncer Revi Rocker 295696A
    - c. Saddle Spinner 152179

### 2.2 SHADE STRUCTURE-ADD ALTERNATE

- A. Shade Structure: Subject to compliance with requirements, provide products by Landscape Structures, 601 7<sup>th</sup> Street South, Delano, MN 55328, (888) 438-6574, [www.info@playsi.com](http://www.info@playsi.com), or approved equal. Local representative: General Recreation, Andy Cush, [andy@gen-rec.com](mailto:andy@gen-rec.com).
- B. Products and Colors
  - 1. SkyWays Triangle Sail (20'x20'x20') Shade, Model #237677
  - 2. Structure 1 Color: Post – Orange, Shade Orange FR
  - 3. Structure 2 Color: Post – Blue, Shade Blue FR

### 2.3 CAST-IN-PLACE CONCRETE

- A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" to produce normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3500 psi (20.7 MPa), 3-inch (75-mm) slump, and 1-inch- (25-mm-) maximum-size aggregate.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, site surface and subgrade drainage, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading required for placing protective surfacing is completed unless otherwise permitted by Architect.

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

### 3.2 PREPARATION

- A. Verify locations of playground perimeter and pathways. Verify that playground layout and equipment locations comply with requirements for each type and component of equipment.

### 3.3 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Anchor playground equipment securely, positioned at locations and elevations indicated.

1. Maximum Equipment Height: Coordinate installed heights of equipment and components with finished elevations of protective surfacing. Set equipment so fall heights and elevation requirements for age group use and accessibility are within required limits. Verify that playground equipment elevations comply with requirements for each type and component of equipment.

B. Post and Footing Excavation: Excavate holes for posts and footings as indicated in firm, undisturbed or compacted subgrade soil.

C. Post Set on Subgrade: Level bearing surfaces with drainage fill to required elevation.

D. Post Set with Concrete Footing: Comply with ACI 301, ACI 301M for measuring, batching, mixing, transporting, forming, and placing concrete.

1. Set equipment posts in concrete footing. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at the correct angle, alignment, height, and spacing.

- a. Place concrete around posts and vibrate or tamp for consolidation. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

2. Embedded Items: Use setting drawings and manufacturer's written instructions to ensure correct installation of anchorages for equipment.

3. Concrete Footings: Smooth top, and shape to shed water.

### 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. 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.
- C. Tests and Inspections: For playground and playground equipment and components during installation and at final completion and to certify compliance with ASTM F 1487, CPSC No. 325.
- D. Prepare test and inspection reports.

END OF SECTION 116800

## SECTION 116800.01 - SPRAYGROUND SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Extent of work is shown on the Drawings and includes but is not limited to:
  - 1. Verify existing and new utility locations.
  - 2. Design and furnish complete sprayground system where indicated in Drawings
  - 3. Furnish and install sprayground system.
  - 4. Layout and stake, trench, install piping, valves, controller, and wiring as well as other necessary appurtenances to provide complete, operational sprayground system.
  - 5. Check, start-up, adjust and demonstrate operation and winterization of system.
  - 6. Provide an Operations and Maintenance Manual.
  - 7. Provide maintenance and adjustments for one (1) season of operation.
  - 8. Warranty and Guarantee.
- B. Related Sections include the following:
  - 1. Division 2 Section "Earthwork".
  - 2. Division 2 Section "Soil Preparation".
  - 3. Division 3 Section "Cast-In-Place Concrete".
  - 4. Division 22 "Plumbing" and Section 221119 Domestic Water Piping Schedules for backflow preventor.
  - 5. Division 26 "Electrical".

#### 1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to water features. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit piping drain valves. Piping is not under pressure.
- C. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and catalogue cuts or equipment data for all of the required components. Include pressure ratings, rated capacities, and settings of selected models for the following:
  - 1. Sprayground equipment including controller and associated valves, pipes, wires, meters, etc.



- B. Shop Drawings: Provide layout drawings of proposed system for review by Landscape Architect and Owner. Show system piping, including plan layout, and locations, types, sizes, capacities, and flow characteristics of piping components. Show wiring diagram. Show areas of spray and overspray.
- C. Record drawings: At project closeout, submit record drawings of installed sprayground system piping and products, in accordance with Division 1 requirements.
- D. Operation and Maintenance Manual: Including, but not limited to:
  - 1. All equipment data, parts specification and manual sheets.
  - 2. Start-up procedures.
  - 3. Routine maintenance requirements and typical system adjustment needs.
  - 4. Winterization procedures.
  - 5. Controller program.
  - 6. Terms and conditions of guarantee on labor and of warranty on products.
  - 7. Record Drawings: As-built record drawings of installed sprayground system piping and electrical conduit. Provide one (1) hardcopy and one (1) digital record in PDF format.
- E. Qualification Data: For qualified Installer.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturing sprayground systems materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Installer's Qualifications: Contractor shall have had experience with at least five (5) other projects of similar scope and complexity and shall perform work with personnel totally familiar with sprayground systems and construction techniques under the supervision of an experienced foreperson.
- C. Applicable requirements of current editions of accepted Standards, Codes and trade practices apply to work of this Section, including, but not limited to:
  - 1. American Society of Testing and Materials (ASTM)
  - 2. National Plumbing Code
  - 3. National Electrical Code (NEC)

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle and protect all materials from damage.
- B. 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.
- C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 PROJECT CONDITIONS

- A. Coordinate installation of sprayground system with storm drainage systems, underground raceways for electrical systems, concrete paving, and stone masonry.
- B. Protect existing and new construction conditions adjacent to and within the limit of work.
  - 1. All necessary precautions for safety including barricades and other protection measures shall be taken during all work.
  - 2. All heavy equipment shall be driven or parked on the site only where approved by Landscape Architect.

3. Elements damaged or disturbed during construction including but not limited to existing pavements, structures, walls, and utility lines (above and below grade) shall be repaired or replaced to the satisfaction of the Owner at the cost of the Contractor.
  4. Repair and replace all active utility lines, above and below grade, damaged in the course of construction operations.
- C. Drawings shall be verified in field. Any discrepancies must be brought to the attention of the Landscape Architect prior to proceeding with work.

## 1.8 SEQUENCING AND SCHEDULING

- A. Coordinate work in this Section with work of all other Sections of the Project Manual.

## 1.9 GUARANTEE

- A. Guarantee work for two (2) years from date of acceptance against all defects in material, equipment and workmanship. Repairs, if required, shall be done promptly. Additional work effected by sprayground system defects including but not limited to utilities, planting, site stonework, and concrete paving shall be the financial responsibility of the Contractor.
- B. Guarantee shall include spring start-up and winterizing of system within the two (2) year time. Winter damage due to improper winterization is the responsibility of the Contractor.
- C. All repairs and servicing required shall be made under the observation of the Owner's maintenance staff. The Contractor shall include training to Owner staff at these times.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Provide new piping materials and factory-fabricated piping products of sizes, types, pressure ratings and capacities as required by manufacturer to install sprayground system.
- B. Contractor is responsible for the design and installation of the system. Landscape Architect and Owner will review submittals and provide information as necessary to assist Contractor in development of system.
- C. All work shall be in compliance with applicable codes and regulations. The Contractor is responsible to obtain required permits and coordination of inspections.

### 2.2 MANUFACTURERS

- A. Sprayground Features – Waterplay Solutions Corp., Local Sales Representative: Kevin Umbreit, Recreation Resource, [KevinU@Recreation-Resource.com](mailto:KevinU@Recreation-Resource.com) or approved equal.
1. Coordinate design and development of sprayground system with Owner and Landscape Architect.

### 2.3 SPRAYGROUND FEATURES

- A. Basis of Design:
1. Model:
    - a. S1 - Solo Spurt 0010-7481
    - b. S2 - Steady Stream 0010-7484
    - c. Morning Grass 1 0002 5250

2.4 PIPE

- A. Pipe schedule and material requirements to be provided by manufacturer.

2.5 ACCESSORIES

- A. Sleeves: Sleeves for pipes passing beneath paving shall conform to ASTM D2241. Minimum diameter of 2 inch or 2 sizes larger than pipe scheduled to pass through them.
- B. PVC Solvent Cement: Cement shall conform to ASTM D2564.

2.6 NOZZLES

- A. Nozzles shall be a high-grade synthetic acetal construction
- B. Nozzles shall be installed flush to concrete, eliminating pinch points and trip hazards.

2.7 DRAIN(S)

- A. Basis of Design: Waterplay DRA-000, Sandstone color. Drain size and location shall be coordinated with site storm drainage and utilities.
- B. Drain(s) shall be ADA compliant.
- C. Drain(s) shall be rated for light vehicle traffic.

2.8 CONTROLLER

- A. See contract plumbing drawings for Controller Rainbird rain sensor and timer with Solenoid Valve Connection.
  - 1. Timer - Intermatic timer that is a SPDT 120v output, 7-day timer. Coordinate with electric motor valve.
  - 2. Electric Motor Valve - Watts LFEMVII-6400-SS, [https://www.watts.com/products/plumbing-flow-control-solutions/shutoff-valves/ball-valves/lfemvii-6400-ss#jl\\_9fd64d5b-372f-458d-a6e5-fd2002f9ab30](https://www.watts.com/products/plumbing-flow-control-solutions/shutoff-valves/ball-valves/lfemvii-6400-ss#jl_9fd64d5b-372f-458d-a6e5-fd2002f9ab30)
  - 3. Manifold, custom 7V, 4In Header, EST-10164.

2.9 WATER SUPPLY

- A. Water supply shall be provided at recessed controls for sprayground as designated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which sprayground system materials and products are to be installed. Locate, identify and protect existing and new below-grade utilities.
- B. Make field measurements necessary for Work noting relationship of sprayground work to work of other trades. Coordinate with other trades.
  - 1. Coordinate with Masonry Contractor as required for sleeving through site walls. Set stakes to identify locations of proposed sprayground system. Obtain Landscape Architect's approval before excavation.
- C. Notify Landscape Architect of any discrepancies between the Contract Documents and field conditions.

- D. Protect plants, walls, slabs and structures, lighting, waterproofing, underdrainage etc., from damage due to work of this Section. Damage to work of another trade shall be reported immediately.
- E. Prior to installation, receive approval from General Contractor to proceed with construction.

### 3.2 EXCAVATION, BACKFILL AND PIPE ASSEMBLY AND INSTALLATION

- A. Excavate and trench to depths indicated on the Drawings.
- B. Install sleeves as required prior to installation of pavement and coordinated with installation of segmental retaining walls.
- C. Backfilling to be done in accordance with Division 2 Section "Earthwork".
- D. Trenching and Backfilling:
  - 1. Excavate trench to proper depth as shown or specified.
  - 2. Minimum trench width shall be 3 1/2 inches.
  - 3. Over excavate trenches deeper than required in soils containing rock or other hard material that might damage pipe and backfill to proper depth with selected fine earth or sand.
  - 4. Backfill and hand tamp over excavation prior to installing piping.
  - 5. Keep trenches free of obstructions and debris that would damage pipe.
  - 6. Sprayground piping shall not be installed in same trench as heating ducts, electric ducts, storm and sanitary sewer lines, water and gas mains.
- E. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated on D-1.7 unless deviations are approved on Coordination Drawings.
- F. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- G. Install piping free of sags and bends.
  - 1. Snake pipe in trench at least 1 foot per 100 feet of pipe to allow for thermal expansion.
- H. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- I. Install fittings for changes in direction and branch connections.
- J. Install expansion loops in control-valve boxes for plastic piping.
- K. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- L. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- M. Install piping in sleeves as indicated on the Drawings.
- N. No pipe shall be laid when, in the opinion of the Owner, trench or weather conditions are unsuitable. When pipe laying is not in progress, open ends of installed pipe shall be closed by approved means to prevent entrance of trench water and other foreign material into the line. Enough backfill shall be placed in the center sections of the pipe to prevent floating. Any pipe that has floated shall be removed from trench and re-laid.
- O. Record pipe and wire location(s) on record drawings.

### 3.3 SPRAYGROUND FEATURE INSTALLATION

- A. Install features per manufacturers instructions.

- 3.4 DRAIN(S)
  - A. Drain location(s) shall be coordinated with site storm drainage and utilities.
- 3.5 ELECTRICAL CONNECTIONS AND CONTROL WIRE
  - A. Conform to National Electrical Code (NEC) and local electrical codes.
  - B. Provide electrical connection to system as designated on the Drawings.
- 3.6 IDENTIFICATION
  - A. Identify system components. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
    - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- 3.7 CLEAN UP
  - A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.
- 3.8 STARTUP SERVICE
  - A. Perform startup service.
    - 1. Complete installation and startup checks according to manufacturer's written instructions.
    - 2. Verify that controllers are installed and connected according to the Contract Documents.
    - 3. Verify that electrical wiring installation complies with manufacturer's submittal.
- 3.9 ADJUSTING
  - A. Adjust settings of controllers.
  - B. Adjust automatic control valves to provide flow rate at rated operating pressure required by manufacturer.
  - C. Adjust sprayground system for optimal performance.
- 3.10 MAINTENANCE DURING GUARANTEE PERIOD
  - A. General: Perform procedures set forth in the submitted and approved maintenance program for the duration of Guarantee Period.
  - B. Winterize sprayground system in accordance with manufacturer's recommendations.
- 3.11 CLOSE OUT
  - A. Instruct the Owner's personnel in the proper operation, maintenance, repairs and winterization of the system.
  - B. At completion of walk through and instruction of Owner's personnel, Contractor shall insure that the following are complete.
    - 1. Permits required for this work are signed-off by appropriate parties and copies furnished to Owner.
    - 2. Maintenance and Operating Manuals and warranty cards are complete and delivered to Owner, including record drawings and other required items.

END OF SECTION 116800.01

## SECTION 116833 - ATHLETIC 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 the basketball system and player bench.
- B. Related Sections:
  - 1. Section 321216 "Asphalt Paving" for surfacing under and around equipment.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Basketball System.
  - 2. Player Bench
- B. Qualification Data: For qualified Installer, manufacturer and testing agency.
- C. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For equipment and finishes to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: To be approved by Philadelphia Parks and Recreation.
- B. Installer Qualifications: An employer of workers approved by manufacturer.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 ATHLETIC EQUIPMENT

- A. Basketball System: Subject to compliance with requirements, provide products by Bison Inc., 603 L Street, Lincoln, NE, 68508, 1 (800) 247-7668, or approved equal.
  - 1. Basketball System Item Single Model #BA873-BK, Double Model #BA872-BK. The Playground – 6" Sq. Pole with 66" Play Safe Area – 72" Acrylic Backboard, Fixed Goal, and Edge/Protector Padding.
- B. Players Bench: Subject to compliance with requirements, provide furnishings manufactured by Dumor, PO Box 142, Mifflintown, PA 17059, 1-800-598-4018, or approved comparable product.
  - 1. Player Bench Item: Dumor 105-80PL, S-1 Mounting. Finish: Powdercoat Black with recycled plastic top in gray.

### 2.2 CAST-IN-PLACE CONCRETE

- A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" to produce normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3500 psi (20.7 MPa), 3-inch (75-mm) slump, and 1-inch- (25-mm-) maximum-size aggregate.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, site surface and subgrade drainage, mounting surfaces, 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. Verify locations of perimeter and pathways. Verify that equipment layout complies with requirements for each type and component of equipment.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of mini-pitch system where required.
- B. Unless otherwise indicated, install mini-pitch after asphalt top coat has been completed, but before color coating has been installed.
- C. Install basketball equipment in footings as per manufacturer's recommendations.
- D. Install equipment level, plumb, true, and securely anchored at locations indicated on Drawings, and as per Manufacturer.

END OF SECTION 116833

## SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Walk-off carpet

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Items penetrating floor mats and frames, including door control devices.
  - 2. Divisions between mat sections.
  - 3. Perimeter floor moldings and frames.
  - 4. Connections at thresholds and door hardware.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

### PART 2 - PRODUCTS

#### 2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

- A. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

#### 2.2 MODULAR TILE ENTRANCE MAT

- A. Basis of Design Product: Subject to compliance with requirements, provide Mats, Inc. Diagonal Tile, or equal by one of the following manufacturers.
  - 1. Nystrom Building Products
  - 2. Construction Specialties, Inc.
- B. Product:
  - 1. Construction: 100% solution-dyed polypropylene fiber with bitumen backing.
  - 2. Size: 19 11/16" x 19 11/16" square.
  - 3. Thickness: 3/8-inch.
  - 4. Color: As selected by Architect from manufacturer's standard colors.

5. Installation: quarter-turn.

C. Performance:

1. Surface Flammability: ASTM D2859 Pass
2. Smoke Density: ASTM E662 Pass

D. Accessory Products

1. Adhesive: manufacturer's recommended adhesive for modular tile installation.

## 2.3 FRAMES AND TRIM

A. Surface-Mounted Frames:

1. Aluminum Color: As selected by Architect from full range of industry colors and color densities, including optional colors.
2. Frames shall be surface-mounted to concrete slab.
3. At exterior doors, provide aluminum threshold frame. Coordinate installation of door hardware threshold with walk-off mat.
4. Frame Type: 'L' frame.

## 2.4 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- B. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.
- B. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.

### 3.2 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

## SECTION 129300 - SITE FURNISHINGS

### 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. Bench – backless and backed
2. Trash Receptacle
3. Bike Rack
4. Bollard
5. Flagpole and flags

- B. Related Requirements:

1. Section 321613 "Cast-in-Place Concrete" for installing equipment and/or anchor bolts cast in concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Structural calculations: for flagpoles indicated to comply with certain design loadings, include structural analysis data signed and sealed by qualified professional engineer responsible for their preparation.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Contractor shall have had experience with at least three (3) other projects of similar scope and complexity and shall perform work with personnel totally familiar with furnishings installation and construction techniques under the supervision of an experienced foreperson.
- B. Manufacturer: An experience company specializing in the manufacture of products specified in this Section with a record of successful in-service performance.

- C. Source Limitations: Obtain each product specified from a single source with resources to provide components of consistent quality in appearance and physical properties.
  - 1. Obtain flagpoles as a complete unit from a single manufacturer, including fittings, accessories, bases and anchorage devices.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle and protect all materials from damage.
- B. Spiral wrap flagpoles with heavy kraft paper or other weather-tight wrapping and enclose in a hard fiber tube or other protective container.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
  - 1. Follow accepted industry standards when placing concrete footings in extreme cold weather.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Anchors, Fasteners, Fittings, and Hardware: Provide Stainless steel; commercial quality, tamperproof, vandal and theft resistant unless indicated otherwise on the Drawings.
- B. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.
- C. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

#### 2.2 BENCH

- A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor, Inc., P.O. Box 142, Mifflintown, PA 17059, 717-436-2106 or 800-598-4018, [www.dumor.com](http://www.dumor.com), or approved comparable product.
  - 1. Backless Model: 164-60
  - 2. Backed Model: 160-60
  - 3. Finish / Color: Powdercoat / Black.
  - 4. With center arm and 'Fairmount Park' security panel.
  - 5. Mount: As shown on Drawings.

### 2.3 TRASH RECEPTACLE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor, PO Box 142, Mifflintown, PA 17059, 1-800-598-4018, or approved comparable product.
1. Model: 157-32-FTO
  2. Finish / Color: Powdercoat / Black.
  3. Mount: As shown on Drawings.

### 2.4 BIKE RACK

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide furnishings manufactured by Dumor, PO Box 142, Mifflintown, PA 17059, 1-800-598-4018, or approved comparable product.
1. Model: 83, embedded mounting option.
  2. Finish / Color: Black Powdercoat.

### 2.5 BOLLARD

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide furnishings manufactured by Dumor, Inc., P.O. Box 142, Mifflintown, PA 17059, 717-436-2106 or 800-598-4018, [www.dumor.com](http://www.dumor.com), or approved comparable product.
1. Model: 400-42, S-1
  2. Finish / Color: Black

### 2.6 FLAGPOLES

- A. Manufacturers:
1. Acme Lingo Flagpoles LLC.
  2. Concord Industries, Inc.
  3. Ewing Flagpoles
  4. Morgan-Francis Flagpoles and Accessories
  5. Or approved equal.
- B. Pole Construction, General: Construct poles and ship to Project site in one piece. If more than one piece is necessary, provide snug-fitting precision joints with self-aligning, internal splicing sleeve arrangement for weathertight, hairline field joints.
- C. Aluminum Flagpoles: Fabricate from seamless, extruded tubing complying with ASTM B 241, alloy 6063, with a minimum wall thickness of 3/16 inch. Heat treat after fabrication to comply with ASTM B 597, temper T6.
1. Provide cone-tapered aluminum flagpoles.
  2. Flagpole height: 30 feet.
- D. Foundation Tube: Galvanized corrugated-steel foundation tube, 0.0635-inch minimum wall thickness, sized to suit flagpole and installation. Provide with 3/16-inch steel bottom plate and support plate; 3/4-inch diameter, steel ground spike; and steel-centering

wedges all welded together. Galvanized steel parts, including foundation tube, after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.

1. Provide ground spike at pavement-mounted metal flagpoles.
  2. Provide aluminum flashing collar; finish to match flagpole
- E. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match pole-butt diameter.
1. 0.063-inch spun aluminum, finished to match flagpole.
- F. Internal Halyard, Winch System; Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
- G. Halyard Flag Snaps: Provide 2 swivel snap hooks per halyard, as follows:
1. Stainless steel.
  2. Provide with neoprene or vinyl covers.
- H. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
1. Aluminum Finish: Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
  2. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

## 2.7 FLAGS

- A. Provide one United States of America flag and one City of Philadelphia flag. Provide flags with individually embroidered or sewn components. Provide premium quality 100% nylon, all weather flags. Provide 5' x 8' flags or as directed by the Client.
- B. Manufacturers:
1. Annin Flagmakers.
  2. Eder Flag Manufacturing Co. Inc.
  3. Valley Forge Flag Company
  4. FlagZone
  5. Or approved equal.



### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

#### 3.3 CLEANING

- A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 129300

## SECTION 220517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.

#### 1.3 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. GPT; an EnPro Industries company.
- B. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

#### 2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. GPT; an EnPro Industries company.
  - 4. Metraflex Company (The).
- B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

### 2.3 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Plastic or rubber waterstop collar with center opening to match piping OD.

### 2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### 2.5 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Polymeric Systems, Inc.
    - c. Sherwin-Williams Company (The).
    - d. The Dow Chemical Company.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- 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.
- 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 slabs and walls without sleeve-seal system.
- 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 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.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, 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.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

- C. Secure nailing flanges to concrete forms.
- D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. 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.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves or Sleeve-seal fittings.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Interior Partitions:
    - a. Piping Smaller Than NPS 6: PVC pipe sleeves.

END OF SECTION 220517

## SECTION 220518 - ESCUTCHEONS 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. Escutcheons.
  - 2. Floor plates.

#### 1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

#### 1.4 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Jones Stephens Corp.
  - 3. Keeney Manufacturing Company (The).
  - 4. Mid-America Fittings, Inc.
  - 5. ProFlo; a Ferguson Enterprises, Inc. brand.

#### 2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

## 2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- 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.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
    - d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
    - h. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - i. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
    - j. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - 2. Escutcheons for Existing Piping to Remain:
    - a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

- e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - f. Bare Piping in Equipment Rooms: Split-plate, 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: One-piece, floor plate.
  - 2. Existing Piping: Split floor plate.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518



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## SECTION 220519 - METERS AND GAGES 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. Liquid-in-glass thermometers.
- 2. Thermowells.
- 3. Dial-type pressure gages.
- 4. Gage attachments.

- B. Related Sections:

- 1. Section 221116 "Domestic Water Piping" for water meters inside the building.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

- 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. Terrice, H. O. Co.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch (152-mm) nominal size.
4. Case Form: Back angle or Straight.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.2 THERMOWELLS

### A. Thermowells:

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: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.3 PRESSURE GAGES

### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. Ashcroft Inc.
  - b. Trerice, H. O. Co.
  - c. Watts; a Watts Water Technologies company.
  - d. Weiss Instruments, Inc.
  - e. Weksler Glass Thermometer Corp.
2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install thermometers in the following locations:
  1. Inlet and outlet of each water heater.
- I. Install pressure gages in the following locations:
  1. Building water service entrance into building.
  2. Inlet and Outlet of Gas Pressure Booster.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
  - 1. Compact-style, liquid-in-glass type.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F and 0 to 150 deg C.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
  - 1. Sealed, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each Gas pressure-Booster shall be the following:
  - 1. Sealed direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi and 0 to 600 kPa.
- B. Scale Range for Domestic Water Piping: 0 to 100 psi and 0 to 600 kPa.

END OF SECTION 220519

## SECTION 220523 - VALVES AND SPECIALTIES FOR PLUMBING PIPE

### 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. Drain valves.
  - 3. Water-hammer arresters.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. NRS: Non-rising stem.
- C. OS & Y: Outside screw and yoke.
- D. RS: Rising stem

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G 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, 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. Retain "NSF Compliance" Paragraph below if products come into contact with potable water.
- D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- 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 Actuator Types:
  - 1. Handlever: For quarter-turn valves smaller than NPS 4.
- I. 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.
- J. RS Valves in Insulated Piping: With 2-inch stem extensions.
- K. Valve Bypass and Drain Connections: MSS SP-45

### 2.2 BRASS BALL VALVES

- A. Two-Piece, Brass Ball Valves with Full Port and Brass Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
  - b. Conbraco Industries, Inc.
  - c. Crane; Crane Energy Flow Solutions.
  - d. DynaQuip Controls.
  - e. Hammond Valve.
  - f. Jomar Valve.
  - g. KITZ Corporation.
  - h. Legend Valve & Fitting, Inc.
  - i. Marwin Valve; Richards Industries.
  - j. Milwaukee Valve Company.
  - k. NIBCO INC.
  - l. Red-White Valve Corporation.
  - m. Stockham; Crane Energy Flow Solutions.
  - n. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-110.
  - 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: Brass.
  - h. Ball: Chrome-plated brass.
  - i. Port: Full.

## 2.3 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.4 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Jay R. Smith Mfg. Co.
  - c. Josam Company.
  - d. MIFAB, Inc.
  - e. Precision Plumbing Products.
  - f. Sioux Chief Manufacturing Company, Inc.
  - g. Tyler Pipe; a subsidiary of McWane Inc.
  - h. Watts; a Watts Water Technologies company.
  - i. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.



3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

### 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 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. 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 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

#### 3.3 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

#### 3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and performing balancing. Replace valves if persistent leaking occurs.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

#### 3.5 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 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.

3.6 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Two-piece, brass ball valves with full port and brass trim.

END OF SECTION 220523

## SECTION 220523.12 - 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. Bronze 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 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, 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.

### 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 B16.18 for solder-joint connections.
  - 3. 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. 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 Brass 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. Crane; a Crane brand.
    - c. Hammond Valve.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. WATTS.
  - 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: Brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Full.
- B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. Crane; a Crane brand.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. WATTS.
  
2. Description:
  - a. Standard: MSS SP-110 or MSS SP-145.
  - b. CWP Rating: Minimum 200 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Press.
  - f. Press Ends Connections Rating: Minimum 200 psig.
  - g. Seats: PTFE or RPTFE.
  - h. Stem: Brass.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.
  - k. O-Ring Seal: Buna-N or EPDM.

### 2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass 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. Crane; a Crane brand.
    - c. Hammond Valve.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. WATTS.
  
  2. Description:
    - a. Standard: MSS SP-110 or MSS-145.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Bronze or brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Full.
  
- B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. Crane; a Crane brand.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. WATTS.
  
2. Description:
  - a. Standard: MSS SP-110 or MSS-145.
  - b. CWP Rating: Minimum 200 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Bronze.
  - e. Ends: Press.
  - f. Press Ends Connections Rating: Minimum 200 psig.
  - g. Seats: PTFE or RTPFE.
  - h. Stem: Bronze or brass.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.
  - k. O-Ring Seal: EPDM or Buna-N.

## 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 220553 "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 Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

### 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 brass trim. Provide with threaded solder or press connection-joint ends.
  - 2. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with threaded solder or press connection-joint ends.
  - 3. Iron ball valves, Class 150.

END OF SECTION 220523.12

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## SECTION 220523.14 - 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 Annex G.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads.
  - 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.

## 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 B16.18 for solder joint.
  - 3. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.
- 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.

### 2.2 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze, Swing Check Valves with Bronze Disc:
  - 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. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; Crane Energy Flow Solutions.
    - g. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig (1380 kPa).
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded or soldered. See valve schedule articles.
    - f. 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. 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 check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.

### 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 valve applications are not indicated, use the following:
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing: Threaded or soldered.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Bronze swing check valves, Class 125, bronze disc with soldered or threaded end connections.

END OF SECTION 220523.14

## SECTION 220529 - 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. Metal framing systems.
  - 3. Thermal-hanger shield inserts.
  - 4. Fastener systems.
  - 5. Pipe positioning systems.
  - 6. Equipment supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. 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 equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.5 ACTION SUBMITTALS

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

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.7 QUALITY ASSURANCE

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

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 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 or hot dipped.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

#### B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

### 2.2 METAL FRAMING SYSTEMS

#### A. MFMA Manufacturer Metal Framing Systems:

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. B-line, an Eaton business.
  - b. Unistrut; Part of Atkore International.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

### 2.3 THERMAL-HANGER SHIELD INSERTS

#### 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. National Pipe Hanger Corporation.
2. Pipe Shields Inc.
3. Piping Technology & Products, Inc.

#### B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) 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 (688-kPa) minimum compressive strength.
- D. For Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

## 2.4 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.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, 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 (34.5-MPa), 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) 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.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads 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.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. 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.
- L. 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.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.



- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
  - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
  - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
  - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 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.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for 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.

### 3.4 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 (40 mm).

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 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-69 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 finish.
- D. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- E. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Use thermal-hanger shield inserts for insulated piping and tubing.
- G. 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 (DN 15 to DN 750).
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), 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 (DN 20 to DN 200).
  - 7. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
  - 8. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
  - 9. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

10. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  11. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  12. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
  13. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
  14. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  15. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  16. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- H. 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 (DN 24 to DN 600).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- I. 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 up to 6 inches (150 mm) for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) piping installations.
- J. 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-joint 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 (340 kg).
    - b. Medium (MSS Type 32): 1500 lb (680 kg).
    - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
  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.
- K. 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.
- L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

## SECTION 220553 - IDENTIFICATION 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. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Valve tags.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Valve Schedules: For each piping system to include in maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Brimar Industries, Inc.
    - c. Champion America.
    - d. Craftmark Pipe Markers.
    - e. Seton Identification Products.
  - 2. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 3. Letter Color: Black.
  - 4. Background Color: Yellow.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. 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.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Champion America.
  - 4. Craftmark Pipe Markers.
  - 5. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Champion America.
  - 4. Craftmark Pipe Markers.
  - 5. Seton Identification Products.

- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- 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 pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

## 2.4 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Champion America.
  - 4. Craftmark Pipe Markers.
  - 5. Seton Identification Products.
- B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain or beaded chain.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION 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.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. 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. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
  - 1. Domestic Water Piping including cold water, hot water and hot water return.
    - a. Background: Safety green.
    - b. Letter Colors: White.
  - 2. Natural Gas Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.

### 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.
  - 2. Valve-Tag Colors:
    - a. Cold Water: Natural.
    - b. Hot Water: Natural.
  - 3. Letter Colors:



- a. Cold Water: White.
- b. Hot Water: White.

END OF SECTION 220553

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## SECTION 220719 - 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.

#### 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).
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.4 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.

#### 1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "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 for space required for maintenance.

#### 1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," article 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.
    - c. K-Flex USA.
- 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.
    - b. Knauf Insulation.
  - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
  - 3. 850 deg F.
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. 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 Adhesive: Solvent-based adhesive.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.

- b. Armacell LLC.
  - c. Foster Brand; H. B. Fuller Construction Products.
  - d. K-Flex USA.
- 2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  - 3. Wet Flash Point: Below 0 deg F.
  - 4. Service Temperature Range: 40 to 200 deg F.
  - 5. Color: Black.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.

## 2.3 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

## 2.4 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

## 2.5 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Avery Dennison Corporation, Specialty Tapes Division.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
  - 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 C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. 3M Industrial Adhesives and Tapes Division.
  - b. Avery Dennison Corporation, Specialty Tapes Division.
  - c. Ideal Tape Co., Inc., an American Biltrite Company.
  - d. Knauf Insulation.
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.

## 2.6 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

## 2.7 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Just Manufacturing.
  - b. Plumberex Specialty Products, Inc.
  - c. Truebro.
  - d. 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.

## 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.

### 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. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- 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. Apply adhesives and sealants at manufacturer's recommended coverage.
- J. 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.
  - 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 on seams and joints and at ends adjacent to pipe flanges and fittings.
- K. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- M. 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.
- N. 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 Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

### 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 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.

### 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 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.
- C. 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 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.

C. 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 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.

### 3.9 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.

### 3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1/2 inch thick.

- b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  - 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Roof Drain and Overflow Drain Bodies:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1/2 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

END OF SECTION 220719

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## SECTION 221116 - 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. Piping joining materials.
  - 3. Transition fittings.
  - 4. Dielectric fittings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report upon completion to owner.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Owner no fewer than five days in advance of proposed interruption of water service.
  - 2. Do not interrupt water service without Owner's written permission.

### 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. Include marking "NSF-pw" on piping.

## 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 K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. 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.
- G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. Elkhart Products Corporation.
    - c. NIBCO INC.
  - 2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
  - 3. Minimum 200-psig working-pressure rating at 250 deg F.
- H. Copper Push-on-Joint Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. Elkhart Products Corporation.
    - c. NIBCO INC.
  - 2. Description:
    - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
    - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

## 2.3 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.

## 2.4 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.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser, Inc.
    - c. Ford Meter Box Company, Inc. (The).
    - d. Jay R. Smith Mfg. Co.
- D. Plastic-to-Metal Transition Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. Harvel Plastics, Inc.
    - c. Sioux Chief Manufacturing Company, Inc.
  2. Description:
    - a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
    - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

## 2.5 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 Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. Matco-Norca.
  2. Standard: ASSE 1079.
  3. Pressure Rating: 125 psig minimum at 180 deg F.
  4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. Matco-Norca.
  2. Standard: ASSE 1079.
  3. Factory-fabricated, bolted, companion-flange assembly.
  4. Pressure Rating: 125 psig minimum at 180 deg F.
  5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Calpico, Inc.
    - b. Central Plastics Company.
    - c. Pipeline Seal and Insulator, Inc.
  2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig.
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Division 31 for excavating, trenching, and backfilling.

### 3.2 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. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. 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.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 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.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze 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. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- H. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.
- 3.4 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 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.
- 3.5 DIELECTRIC FITTING INSTALLATION
- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- 3.6 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "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 and 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. Support horizontal piping within 12 inches of each fitting.
  - D. Support vertical runs of copper tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.7 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 water-service piping with shutoff valve; extend and connect to the following:
  1. Water Heater/Boiler: Cold-water inlet and hot-water outlet piping shall match existing conditions and pipe, and shall not be smaller than sizes of equipment connections.
  2. Plumbing Fixtures: Cold- and hot-water-supply piping shall match existing conditions, and shall not be smaller than that required by plumbing code.

### 3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.9 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. Reinspection: 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.
- 3.10 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. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
    4. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
    5. Check plumbing specialties and verify proper settings, adjustments, and operation.
- 3.11 CLEANING
- A. 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 Philadelphia Water Department; 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.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.12 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service 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.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

### 3.13 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 or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

## SECTION 221119 - 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. Backflow preventers.
  - 2. Non-Freeze Wall hydrants.
  - 3. Water-hammer arresters.
  - 4. Trap-seal primer systems.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 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. Potable-water piping and components shall comply with NSF 61 and NSF 14.
- B. Comply with NSF 372 for low lead.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

#### 2.3 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: 2 NPS.
6. Design Flow Rate: 80 gpm.
7. Selected Unit Flow Range Limits: 100 gpm maximum.
8. Pressure Loss at Design Flow Rate: 12 psig for sizes NPS 2.
9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550..
10. End Connections: Threaded for NPS 2 and smaller.
11. Configuration: Designed for horizontal, straight-through flow.
12. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

#### 2.4 Wall Hydrant

##### A. Non-Freeze Wall Hydrant:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Woodford Manufacturing Company.
  - c. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 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 building exterior: Rough bronze.
10. Operation for building exterior: Operating key.
11. Include operating key with each operating-key wall hydrant.
12. Non-freeze type wall hydrant.

#### 2.5 WATER-HAMMER ARRESTERS

##### A. Water-Hammer Arresters:

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



- a. Jay R. Smith Mfg. Co.
  - b. Josam Company.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. WATTS.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
  3. Type: Copper tube with piston.
  4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.6 TRAP-SEAL BARRIER TYPE

### A. Trap-Seal, Barrier Type Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith.
  - b. Sureseal.
  - c. Zurn.
2. Standard: ASSE 1072, Performance Requirements for Barrier Type Seal Protection Devices.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system. Backflow preventer to be 100' from the property line, if beyond, install backflow preventer in hot box. Coordinate with Civil Engineer.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.
- C. Barrier Type Trap-Seals shall fit sanitary pipe to provide a barrier to minimize the evaporation of the trap seal of a floor drain. Seal open to allow drainage, and shall be closed when there is no flow.

### 3.2 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. Reduced-pressure-principle backflow preventers.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221119

## SECTION 221316 - 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. Copper tube and fittings.
  - 4. Specialty pipe fittings.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports and testing to be submitted to owner.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste 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 Philadelphia Parks and Recreation (Owner) no fewer than five days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

#### 1.6 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

## 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. Charlotte Pipe and Foundry Company.
  - 2. NewAge Casting.
  - 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.
- D. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

### 2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Charlotte Pipe and Foundry Company.
  - 2. NewAge Casting.
  - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings: ASTM A 888 or CISPI 301.
- C. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. Dallas Specialty & Mfg. Co.
    - c. Fernco Inc.
    - d. Ideal Clamp Products, Inc.

- e. NewAge Casting.
- f. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and CISPI 310.

## 2.5 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Unshielded, Nonpressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Dallas Specialty & Mfg. Co.
      - 2) Fernco Inc.
      - 3) Froet Industries LLC.
    - b. Standard: ASTM C 1173.
    - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - d. End Connections: Same size as and compatible with pipes to be joined.
    - e. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
- B. Dielectric Fittings:
  - 1. Dielectric Unions:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Capitol Manufacturing Company.
    - 2) Central Plastics Company.
    - 3) WATTS.
    - 4) Zurn Industries, LLC.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 125 psig minimum at 180 deg F.
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
2. Dielectric Flanges:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Capitol Manufacturing Company.
    - 2) Central Plastics Company.
    - 3) WATTS.
    - 4) Zurn Industries, LLC.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: 125 psig minimum at 180 deg F.
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

### 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.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. 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.
- K. 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.
- L. 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. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. 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."
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

- O. 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. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked 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.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

### 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.
- B. Dielectric Fittings:



1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  4. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  5. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron and copper 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. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical runs of cast iron and copper soil piping to comply with MSS-58, 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 existing sanitary piping.
- C. Connect waste and vent piping to the following:
  1. Plumbing Fixtures: Connect waste piping to existing system, but not smaller than required by plumbing code.
  2. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  3. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- 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.

### 3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.

- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours 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 final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

### 3.9 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. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.10 PIPING SCHEDULE

- A. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
  1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
  2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- B. Aboveground, soil and waste piping NPS 5 and larger shall be 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 the following:
  1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
  2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
    - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
  3. 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; calking materials; and calked joints.
  2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, soil and waste piping NPS 5 and larger shall be the following:
  1. Service class, cast-iron soil piping; calking materials; and calked joints.
  2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

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## SECTION 221319 - 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 ACTION SUBMITTALS

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

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

#### 2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
  - 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.
  - 3. Size: Same as connected drainage piping

4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

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 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: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with setscrews or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy or Polished bronze.
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:

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: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure Plug:
  - a. Brass.
  - b. Countersunk or raised head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round, Insert material wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. 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.
- B. 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.
- C. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
  2. Size: Same as connected stack vent or vent stack.
- D. Frost-Resistant Vent Terminals:
1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
  2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

## 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.
- 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. Install air-gap fittings on draining-type backflow preventers to discharge into sanitary drainage system.
- E. Install vent caps on each vent pipe passing through roof.
- F. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

- G. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- H. Install wood-blocking reinforcement for wall-mounting-type specialties.
- I. Install traps on plumbing specialty drain outlets.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "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 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 221319



## SECTION 230513 - 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 ac 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.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. 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.

#### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy 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 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- 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. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

#### 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.

3. Capacitor start, inductor run.
  4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. 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.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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## SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal fittings.
  - 4. Grout.

#### 1.3 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

#### 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Jay R. Smith Mfg. Co.
  - 2. Zurn Industries, LLC.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Metraflex Company (The).
  - 3. Proco Products, Inc.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
  - 1. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- B. 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 appropriate for size, depth, and location of joint.

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in slabs.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipe penetrations of membrane waterproofing.
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Extend cast-iron sleeve fittings below slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- B. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal fittings.
  2. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6: Galvanized steel pipe sleeves with sleeve-seal fittings.
  3. Interior Partitions:
    - a. Piping Smaller Than NPS 6: PVC-pipe sleeves.

END OF SECTION 230517

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## SECTION 230518 - ESCUTCHEONS FOR HVAC 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. Escutcheons.

#### 1.3 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With rough-brass finish and setscrew fastener.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- 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 piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, cast-brass type.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with finish.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC 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. Pipe stands.
  - 3. Equipment supports.
- B. Related Sections:
  - 1. Section 233113 "Metal Ducts" for duct hangers and supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC 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.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Metal pipe hangers and supports.
  - 2. Pipe stands.
  - 3. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 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 or hot dipped.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

- B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 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: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

2.3 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel supported from building structure.

2.4 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, 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 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Pipe Stand Installation:
  1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- E. Install hangers and supports to allow controlled thermal 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.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. 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.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. 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.
- J. 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.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to support equipment from building structure walls.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for 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.

### 3.4 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.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 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-69 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 finish.
- 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 and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. 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. 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.
  - 3. 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.
  - 4. 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.
  - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- I. 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.
- J. 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 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.
- K. 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-joint 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.
- L. 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.
- M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 230529

## SECTION 230553 - IDENTIFICATION FOR HVAC 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. Equipment labels.
  - 2. Pipe labels.

#### 1.3 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.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brimar Industries, Inc.
    - b. Champion America.
    - c. Marking Services, Inc.
    - d. Seton Identification Products.
  - 2. Material and Thickness: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
  - 3. Letter Color: Black.
  - 4. Background Color: Yellow.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  7. Fasteners: Stainless-steel rivets.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. 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.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brimar Industries, Inc.
  2. Champion America.
  3. Marking Services Inc.
  4. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: Size letters according to ASME A13.1 for piping.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION 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.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. 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. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
  - 1. Refrigerant Piping: White letters on a safety-green background.
  - 2. Natural Gas Piping: Black letters on a yellow background.

END OF SECTION 230553

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## SECTION 230593 - 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-air-volume systems.
  - 2. Control system 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. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

#### 1.4 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. Certified TAB reports.
- C. Sample report forms.
- D. 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.

## 1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC, NEBB, or TABB.
  1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB, or TABB.
  2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB, or TABB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## 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 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 equipment performance data including fan 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.

- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. 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.
- I. Examine operating safety interlocks and controls on HVAC equipment.
- J. 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. Clean filters are installed.
    - d. Fans are operating, free of vibration, and rotating in correct direction.
    - e. Automatic temperature-control systems are operational.
    - f. Ceilings are installed.
    - g. Windows and doors are installed.
    - h. 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", ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, 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 in Section 233300 "Air Duct Accessories."



3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

#### 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. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. 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.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

#### 3.5 PROCEDURES FOR CONSTANT-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
  1. Verify that the system is under control.
  2. Calibrate and balance unit for minimum design outdoor airflow as follows:
    - a. Measure airflow and adjust calibration factor as required for design airflow. Record calibration factor.
    - b. Set outside-air damper for proper position that simulates minimum outdoor-air conditions.
    - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, an air inlet traverse may be acceptable.
  3. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan inlet or through the flexible connection.

- b. Measure static pressure across each component that makes up the air-handling system.
  - c. Report any artificial loading of filters at the time static pressures are measured.
- 4. Set final outside airflow to the fan while operating.
  - 5. Verify final system conditions as follows:
    - a. Re-measure and confirm that minimum outdoor airflow is within design. Readjust to match design if necessary.
    - b. Re-measure final fan operating data, rpms, volts, amps, and static profile.
    - c. Mark final settings.

### 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.

### 3.7 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:

- 1. Verify temperature control system is operating within the design limitations.
- 2. Confirm that the sequences of operation are in compliance with Contract Documents.
- 3. Verify that controllers are calibrated and function as intended.
- 4. Verify that controller set points are as indicated.
- 5. Verify the operation of lockout or interlock systems.
- 6. Verify the operation of damper actuators.
- 7. Verify that controlled devices are properly installed and connected to correct controller.
- 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
- 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### 3.8 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: Plus or minus 10 percent.
- 2. Air Outlets and Inlets: Plus or minus 10 percent.

### 3.9 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
  3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. 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. Engineer's name and address.
  6. Contractor's name and address.
  7. Report date.
  8. Signature of TAB supervisor who certifies the report.
  9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  10. 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.
  11. Nomenclature sheets for each item of equipment.
  12. Notes to explain why certain final data in the body of reports vary from indicated values.
  13. Test conditions for fans performance forms including the following:
    - a. Settings for outdoor-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Other system operating conditions that affect performance.
- D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.

- f. Unit arrangement and class.
  - g. Discharge arrangement.
  - h. Sheave make, size in inches, and bore.
  - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - j. Number, make, and size of belts.
  - k. Number, type, and size of filters.
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. Center-to-center dimensions of sheave and amount of adjustments in inches.
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. Filter static-pressure differential in inches wg.
  - f. Cooling-coil static-pressure differential in inches wg.
  - g. Heating-coil static-pressure differential in inches wg.
  - h. Outdoor airflow in cfm.
  - i. Return airflow in cfm.
  - j. Outdoor-air damper position.
  - k. Return-air damper position.
- E. Apparatus-Coil Test Reports:
1. Coil Data:
- a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft..
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Refrigerant expansion valve and refrigerant types.

- i. Refrigerant suction pressure in psig.
  - j. Refrigerant suction temperature in deg F.
- F. 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. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - g. 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.
- G. 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.
- H. 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.
- I. Instrument Calibration Reports:
    1. Report Data:
      - a. Instrument type and make.
      - b. Serial number.
      - c. Application.
      - d. Dates of use.
      - e. Dates of calibration.

END OF SECTION 230593

## SECTION 230713 - 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

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed outdoor air.
- B. Related Sections:
  - 1. Section 233113 "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 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. 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.

1.6 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.

1.7 COORDINATION

- A. 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.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," and "Indoor 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.



## 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 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. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 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. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  - 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. Foster Brand; H. B. Fuller Construction Products.
    - b. Knauf Insulation.
    - c. Vimasco Corporation.
  - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Eagle Bridges - Marathon Industries.
  - c. Foster Brand; H. B. Fuller Construction Products.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

## 2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
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. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller Construction Products.
  - c. Vimasco Corporation.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

## 2.5 SEALANTS

A. FSK Flashing Sealants:

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. Childers Brand; H. B. Fuller Construction Products.
  - b. Eagle Bridges - Marathon Industries.
  - c. Foster Brand; H. B. Fuller Construction Products.
  - d. Mon-Eco Industries, Inc.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants:

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. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ideal Tape Co., Inc., an American Biltrite Company.
  - b. Knauf Insulation.
  - c. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ideal Tape Co., Inc., an American Biltrite Company.
    - b. Knauf Insulation.
    - c. 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.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Knauf Insulation.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.

## 2.8 SECUREMENTS

- A. Bands:
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. ITW Insulation Systems; Illinois Tool Works, Inc.
    - b. RPR Products, Inc.
  2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with closed seal.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

- 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) AGM Industries, Inc.
- 2) Gemco.
- 3) Midwest Fasteners, Inc.
- 4) Nelson Stud Welding.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.

- 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. C & F Wire.

## 2.9 CORNER ANGLES

- A. 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.

## 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. Keep insulation materials dry during application and finishing.
- F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- G. Install insulation with least number of joints practical.
- H. 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.
- I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- J. 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 inches o.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.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. 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 Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. 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 Division 7 for firestopping and fire-resistive joint sealers.

### 3.5 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, for 100 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 capacitor-discharge-weld pins and speed washers 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.

### 3.6 FINISHES

- A. Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9.
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  1. Indoor, concealed outdoor air.
- B. Items Not Insulated:



1. Factory-insulated flexible ducts.
2. Flexible connectors.
3. Vibration-control devices.
4. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches, 1.5-lb/cu. ft. nominal density.

END OF SECTION 230713

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## SECTION 230719 - HVAC PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating following HVAC piping systems:
  - 1. Cooling coil condensate drain piping, indoors.
  - 2. Refrigerant suction piping, indoors and outdoors.
  - 3. Refrigerant liquid piping, indoors and outdoors.
  - 4. Refrigerant hot gas piping, indoors and outdoors.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation".
  - 2. Section 232300 "Refrigerant Piping".

#### 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 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting 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.

#### 1.6 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.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment".
- B. Coordinate clearance requirements with piping Installer for piping insulation application.
- C. Coordinate with and comply with Variable Refrigerant Flow manufacturer's insulation requirements.

#### 1.8 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," "Outdoor, Aboveground Piping Insulation Schedule," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in manufacturing process.
- D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.

- b. Armacell LLC; AP Armaflex.
  - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
2. For insulation of Y-type branch fittings in variable refrigerant flow (VRF) piping systems, install VRF system manufacturer's custom Y-type branch-fitting insulation covers.

## 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: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aero seal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  - 2. For indoor applications, adhesive shall have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm) at 43-mil dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 5. Color: White.

## 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.
  - 3. 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 length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for 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. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- 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.
  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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

### 3.4 PENETRATIONS

- A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. 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 Division 7 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "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.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation, except in VRF system where Y-type branch fittings shall have VRF manufacturer's custom insulation covers.
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.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as 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.

3.6 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating for piping located outdoors.

3.7 INDOOR PIPING INSULATION SCHEDULE

A. Cooling Coil Condensate Drain Piping:

1. Insulation shall Flexible Elastomeric.
2. All Pipe Sizes and Pans: 1/2-inch thick.

B. Refrigerant Suction Piping:

1. Insulation shall be Flexible Elastomeric.
2. Insulation Thickness: All pipe sizes, 1-inch thick.

C. Refrigerant Liquid Piping:

1. Insulation shall be Flexible Elastomeric.
2. Insulation Thickness: All pipe sizes, 3/4-inch thick.

D. Refrigerant Hot Gas Piping:

1. Insulation shall be Flexible Elastomeric.
2. Insulation Thickness: All pipe sizes, 3/4-inch thick.



3.8 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction Piping:

1. Insulation shall be Flexible Elastomeric.
2. Insulation Thickness: All pipe sizes, 1-inch thick.
3. Paint insulation with UV-resistant paint of type recommended by insulation manufacturer.

B. Refrigerant Liquid Piping:

1. Insulation shall be Flexible Elastomeric.
2. Insulation Thickness: All pipe sizes, 3/4-inch thick.
3. Paint insulation with UV-resistant paint of type recommended by insulation manufacturer.

C. Hot Gas:

1. Insulation shall be Flexible Elastomeric.
2. Insulation Thickness: All pipe sizes, 3/4-inch thick.
3. Paint insulation with UV-resistant paint of type recommended by insulation manufacturer.

END OF SECTION 230719

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## SECTION 232300 - REFRIGERANT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Refrigerants.
  - 2. Piping.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Strainers.
  - 2. Filter dryers.
- B. Product Data Submittals: For each product.
  - 1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.
- C. Delegated Design Submittals: For refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- D. Shop Drawings:
  - 1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
  - 2. Show interface and spatial relationships between piping and equipment.
  - 3. Shop Drawing Scale: 1/4 inch equals 1 foot.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: For each welder performing shop or field welding on Project.
- B. Field Quality-Control Reports: For each field quality control test and inspection.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding, Brazing, and Fusing Qualifications."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.
- B. Prepare valves and specialties for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads and other end connections.
- C. Use the following precautions during storage:
  - 1. Maintain valve and specialty end protection.
  - 2. Store valves and specialties indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B280, Type ACR.
- B. Wrought-Copper Fittings, Solder Joint: ASME B16.22.
- C. Wrought-Copper Fittings, Brazed Joint: ASME B16.50.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- F. Brazing Filler Metals: AWS A5.8M/A5.8.
- G. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  - 4. Working Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

## 2.2 VALVES AND SPECIALTIES

### A. Diaphragm Packless Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss, Inc.
  - b. Henry Technologies Inc.; The Henry Group.
  - c. Parker Hannifin Corporation.
2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

### B. Packed-Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss, Inc.
  - b. Henry Technologies Inc.; The Henry Group.
  - c. Parker Hannifin Corporation.
2. Body and Bonnet: Forged brass or cast bronze.
3. Packing: Molded stem, back seating, and replaceable under pressure.
4. Operator: Rising stem.
5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
6. Seal Cap: Forged-brass or valox hex cap.
7. End Connections: Socket, union, threaded, or flanged.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

### C. Service Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss, Inc.
  - b. Emerson Climate Technologies; Emerson Electric Co.
  - c. Henry Technologies Inc.; The Henry Group.
2. Body: Forged brass with brass cap, including key end to remove core.
3. Core: Removable ball-type check valve with stainless steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

### D. Refrigerant Locking Caps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & D Valve, LLC.
    - b. JB Industries.
    - c. RectorSeal HVAC; a CSW Industrials Company.
  2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant-charging ports from unauthorized refrigerant access and leakage.
  3. Material: Brass, with protective shroud or sleeve.
  4. Refrigerant Identification: Color-coded, refrigerant specific based on AHRI Guideline N or Universal design.
  5. Special Tool: For installing and unlocking.
- E. Straight-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker Hannifin Corporation.
  2. Body: Welded steel with corrosion-resistant coating.
  3. Screen: 100-mesh stainless steel.
  4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig.
  6. Maximum Operating Temperature: 275 deg F.
- F. Angle-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker Hannifin Corporation.
  2. Body: Forged brass or cast bronze.
  3. Drain Plug: Brass hex plug.
  4. Screen: 100-mesh monel.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 275 deg F.
- G. Moisture/Liquid Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body: Forged brass.

3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color-coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

H. Permanent Filter Dryers: Comply with AHRI 730 I-P.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Danfoss, Inc.
  - b. Emerson Climate Technologies; Emerson Electric Co.
  - c. Henry Technologies Inc.; The Henry Group.
2. Body and Cover: Painted-steel shell.
3. Filter Media: 10 micron, pleated with integral end rings; stainless steel support.
4. Desiccant Media: Activated alumina.
5. Design: Reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.
9. Rated Flow: .
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

## 2.3 REFRIGERANTS

A. R-410A, ASHRAE 34: Pentafluoroethane/Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Arkema Inc.
  - b. DuPont Fluorochemicals Div.
  - c. Genetron Refrigerants; Honeywell International Inc.
  - d. Mexichem Fluor, Inc. (Koura).

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATION SCHEDULES

- A. Refrigerant: R-410A
- B. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

- C. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 4 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- D. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 2 to NPS 4: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- E. Safety-Relief-Valve Discharge Piping for Conventional Air-Conditioning (Cooling-Only) Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.

### 3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gauge taps at inlet and outlet of strainers if they are not an integral part of strainers.
- C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- D. Install a full-size, three-valve bypass around filter dryers.
- E. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- F. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
  - 1. Compressor.
- G. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- H. Install flexible connectors at compressors.
- I. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to authority having jurisdiction.

### 3.3 INSTALLATION OF PIPING, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping in accordance with ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.



- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 8 if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves in accordance with Section 230553 "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.4 PIPE 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 pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."
  - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 ft. long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 ft. or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 ft. or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper tubing and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System must maintain test pressure at the manifold gauge throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- C. Prepare test and inspection reports.

### 3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### 3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves but not bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

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## SECTION 233113 - 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. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

- B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.3 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 performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

- B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.1 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.
- B. Transverse Joints: Select joint types and fabricate according to 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."
- C. Longitudinal Seams: Select seam types and fabricate according to 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."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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."

### 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Ductmate Industries, Inc.
  - b. Lindab Inc.
  - c. McGill AirFlow LLC.
  - d. SEMCO LLC.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round 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."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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."
1. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," 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 SHEET METAL MATERIALS

- A. General Material Requirements: 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.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Factory- or Shop-Applied Antimicrobial Coating:
1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
  2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
  4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  5. Shop-Applied Coating Color: Black.
  6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.



1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. 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.

## 2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
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. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
  2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall.

## 2.5 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 according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 4 inches.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. 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.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
  1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-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.

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. 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. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through electrical equipment rooms and enclosures.
- J. 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.2 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 the 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.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 3. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 4. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.4 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.

### 3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 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 Division 9.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.8 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.

- B. Use service openings for entry and inspection.
1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, actuators, and turning vanes
  6. Supply-air ducts, dampers, actuators, and turning vanes.
  7. Dedicated exhaust and ventilation components and.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  6. Provide drainage and cleanup for wash-down procedures.
  7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### 3.9 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Terminal Units:

- a. Pressure Class: Positive 1-inch wg.
- b. Minimum SMACNA Seal Class: C.
- c. SMACNA Leakage Class for Rectangular: 24.
- d. SMACNA Leakage Class for Round and Flat Oval 24.

2. Ducts Connected to Variable-Air-Volume Air-Handling Units:

- a. Pressure Class: Positive 3-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class: 6.

3. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive 2-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class: 12.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

- a. Pressure Class: Positive or negative 2-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class: 24.

2. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive or negative 2-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class: 12.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

- a. Exposed to Airstream: Match duct material.
- b. Not Exposed to Airstream: Match duct material.

E. Liner:

1. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

- a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) 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."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) 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. 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. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. 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."
  3. 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) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 4) Radius-to Diameter Ratio: 1.5.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- G. 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: Spin in.
2. Round: 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 233113

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## SECTION 233300 - 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. Manual volume dampers.
  - 2. Fire dampers.
  - 3. Flange connectors.
  - 4. Turning vanes.
  - 5. Duct-mounted access doors.
  - 6. Flexible connectors.
  - 7. Flexible ducts.
  - 8. Duct accessory hardware.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Fire-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

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: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. American Warming and Ventilating; a Mestek Architectural Group company.
    - b. McGill AirFlow LLC.
    - c. Nailor Industries Inc.
    - d. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
  - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized steel, 0.064 inch thick.
6. Blade Axles: Nonferrous metal.
7. Bearings:
  - a. Oil-impregnated bronze.
  - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 0.5-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 FIRE DAMPERS

- 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. American Warming and Ventilating; a Mestek Architectural Group company.
  2. Greenheck Fan Corporation.
  3. Nailor Industries Inc.
  4. Ruskin Company.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.

- E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  - 1. Minimum Thickness: 0.138 inch thick, as indicated, and of length to suit application.
  - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal.
- H. Blades: Roll-formed, interlocking 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

## 2.5 FLANGE CONNECTORS

- 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. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc.
  - 3. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.6 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. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc.
  - 3. Duro Dyne Inc.
  - 4. 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 inches wide and double wall for larger dimensions.

## 2.7 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. American Warming and Ventilating; a Mestek Architectural Group company.
  - 2. CL WARD & Family Inc.
  - 3. Ductmate Industries, Inc.
  - 4. McGill AirFlow LLC.
  - 5. Nailor Industries Inc.
  - 6. 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 sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
    - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
  - 1. Door and Frame Material: Galvanized sheet steel.
  - 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
  - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
  - 4. Factory set at 3.0- to 8.0-inch wg
  - 5. Doors close when pressures are within set-point range.
  - 6. Hinge: Continuous piano.
  - 7. Latches: Cam.
  - 8. Seal: Neoprene or foam rubber.
  - 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

## 2.8 DUCT ACCESS PANEL ASSEMBLIES

- 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. 3M.
  - 2. Ductmate Industries, Inc.
  - 3. Flame Gard, Inc.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

## 2.9 FLEXIBLE CONNECTORS

- 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. 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. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
  - 1. Minimum Weight: 16 oz./sq. yd..
  - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
  - 3. Service Temperature: Minus 67 to plus 500 deg F.

## 2.10 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
  2. McGill AirFlow LLC.
  3. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 10 to plus 160 deg F.
  4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
  2. Non-Clamp Connectors: Adhesive plus sheet metal screws.
- 2.11 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.

## 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.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, and stainless-steel accessories in stainless-steel ducts,.
- C. Install backdraft 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.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.

- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. Downstream from manual volume dampers, and equipment.
  - 2. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 3. At each change in direction and at maximum 50-foot spacing.
  - 4. Upstream from turning vanes.
  - 5. Control devices requiring inspection.
  - 6. Elsewhere as required.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped in place.
- O. Connect flexible ducts to metal ducts with draw bands or adhesive plus sheet metal screws.
- P. Install duct test holes where required for testing and balancing purposes.

### 3.2 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 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.

END OF SECTION 233300

## SECTION 238125- CASSETTE DX SPLIT-SYSTEMS WITH HEATING COIL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting and may be connected to ducts.

#### 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring. Distinguish between factory- and field-wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Units shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

- A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Compressors, five years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Modine
  - 2. Sanyo Fisher (U.S.A.) Corp.
  - 3. York International Corp.
  - 4. Carrier Air Conditioning; Div. of Carrier Corporation.
- B. The equipment supplier shall provide all hardware and software necessary to integrate the controls with the BAS. The successful equipment supplier shall provide a list of major integration components that they need to be integrated with BAS.

2.2 CEILING-MOUNTING, CASSETTES EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends;; drain pans with drain connection; knockouts in side for connection to outside air ducts where shown on Drawings.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
- C. Fan: Direct drive, centrifugal fan and integral condensate pump.
- D. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment".

1. Special Motor Features: Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
  - E. Filters: Permanent, cleanable.
  - F. Condensate Pump with float switch to stop cooling action if pump is blocked or fails; and to interface with BAS to register alarm.
  - G. Ceiling discharge/return air grille in standard color selected by Architect.
  - H. Hanger bracket kit.
  - I. Controls: Programmable heating and cooling thermostat.
  - J. Heating Coil: Provide Electric coil with performance as scheduled on Drawings.
- 2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS
- A. Provide Heat Pump condensing unit with performance as scheduled on Drawings
- 2.4 ACCESSORIES
- A. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install pad-mounted compressor-condenser components on equipment rails. Anchor units to supports with removable, rust-resistant fasteners.
- D. Install pipe Pipe portal having multiple boots to accommodate two refrigerant lines, power conduit and controls conduit.
- E. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- F. Install condensate pump, run discharge piping as shown on Drawings. Wire overflow switch to shut off unit and alarm at BAS.

#### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to unit to allow service and maintenance.
- C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform following field tests and inspections and prepare test reports:
  - 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. Remove and replace malfunctioning units and retest as specified above.

### 3.4 STARTUP SERVICE

- A. Engage factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.5 DEMONSTRATION

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 1.

### 3.6 SEQUENCE OF OPERATION

- A. A 24V signal from the thermostat to terminal G supplies power to the blower motors, condensate pump and vane motor (if equipped). A toggle switch on the control box can be used to switch the oscillating vanes on or off. The condensate pump will run continuously during cooling operation, as long as there is a call for cooling. A call for heating, at terminal W or cooling, at terminal Y, will energize the outdoor condensing unit. If condensate float switch detects a high level of water in the condensate tray, the switch will open, activate the condensate pump and disable the heating/cooling signal until the water level drops down to normal. NOTE: provide an electromechanical controls, a thermostat with compressor on/off

minimum time protection. In addition thermostat shall be able to function as stand alone and tie back to a future BAS system. This tie into the BAS system will allow the end user to see the temperature setting in the room.

END OF SECTION 238125

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## SECTION 238239.19 - WALL AND CEILING UNIT 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 wall and ceiling heaters with propeller fans and electric-resistance heating coils.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and 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. Include details of anchorages and attachments to structure and to supported equipment.
  - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

### 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. Berko; Marley Engineered Products.
  - 2. Chromalox, Inc.

3. INDEECO.
4. Markel Products; TPI Corporation.
5. QMark; Marley Engineered Products.
6. Trane.

## 2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- 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.

## 2.3 CABINET

- A. Front Panel: Stamped-steel louver or Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

## 2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

## 2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

## 2.6 CONTROLS

- A. Controls: Unit-mounted thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

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## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Copper building wire.
  2. Metal-clad cable, Type MC.
  3. Fire-alarm wire and cable.
  4. Connectors and splices.

#### 1.2 ACTION SUBMITTALS

- A. Product Data:
1. Copper building wire.
  2. Metal-clad cable, Type MC.
  3. Armored cable, Type AC.
  4. Fire-alarm wire and cable.
  5. Connectors and splices.

### 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Alpha Wire; brand of Belden, Inc.
  2. Belden Inc.
  3. Cerro Wire LLC.
  4. Encore Wire Corporation.
  5. General Cable; Prysmian Group North America.
  6. Okonite Company (The).
  7. Service Wire Co.
  8. Southwire Company, LLC.
  9. 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 B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
  - 1. Type THHN and Type THWN-2. Comply with UL 83.
  - 2. Type XHHW-2. Comply with UL 44.

## 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. AFC Cable Systems; Atkore International.
  - 2. Alpha Wire; brand of Belden, Inc.
  - 3. Belden Inc.
  - 4. Encore Wire Corporation.
  - 5. General Cable; Prysmian Group North America.
  - 6. Okonite Company (The).
  - 7. Service Wire Co.
  - 8. Southwire Company, LLC.
  - 9. 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 B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2. Comply with UL 83.
  - 2. Type XHHW-2. Comply with UL 44.
- H. Armor: Aluminum, interlocked.
- I. Jacket: PVC applied over armor.

## 2.3 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Allied Wire & Cable Inc.
  2. CommScope, Inc.
  3. Comtran Corporation.
  4. Genesis Cable Products; Honeywell International, Inc.
  5. PYROTENAX; brand of nVent Electrical plc.
  6. Prysmian Cables and Systems; Prysmian Group North America.
  7. Rockbestos-Suprenant Cable Corp.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
  2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
  3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

## 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M Electrical Products.
  2. ABB, Electrification Business.
  3. AFC Cable Systems; Atkore International.
  4. Hubbell Utility Solutions; Hubbell Incorporated.
  5. ILSCO.
  6. Ideal Industries, Inc.
  7. NSi Industries LLC.
  8. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  9. Service Wire Co.
  10. 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. Material: Copper.
  - 2. Type: One hole with standard barrels.
  - 3. Termination: Compression.

### 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. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

#### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

#### 3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.
- C. 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.



- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway.
  - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
  - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
    - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
  - 3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
  - 4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. 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.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "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.

### 3.7 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 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7.

### 3.9 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 260519

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## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 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. Grounding (earthing) electrodes.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

#### 1.3 CLOSEOUT SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 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 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. ASTM - Bare Copper Grounding and Bonding Conductor:

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. ERICO; brand of nVent Electrical plc.
  - b. Harger Lightning & Grounding; business of Harger, Inc.
2. 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.

## 2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar.
- 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.
- C. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:
  - 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. ABB, Electrification Business.
    - b. Cooper B-line; brand of Eaton, Electrical Sector.
    - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - d. ERICO; brand of nVent Electrical plc.
    - e. ILSCO.
    - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    - g. Panduit Corp.
  - 2. General Characteristics:
    - a. Clamp Material: Aluminum.
    - b. Listed for outdoor use.
- D. UL KDER - Exothermically Welded Connection:
  - 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. ABB, Electrification Business.
    - b. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
    - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - d. ERICO; brand of nVent Electrical plc.
  - 2. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 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. 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.
- C. UL KDER - Bonding Bushing:
  - 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. ABB, Electrification Business.
    - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - c. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - 2. General Characteristics: Threaded bushing with insulated throat.
- D. UL KDER - Grounding Bushing:
  - 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. ABB, Electrification Business.
    - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - c. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - 2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

## 2.4 GROUNDING AND BONDING HUBS

- A. Description: Hubs with certified grounding or bonding locknut.
- 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.
- C. UL KDER - Grounding and Bonding Hub:
  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. ABB, Electrification Business.
    - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  2. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

## 2.5 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. 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. ABB, Electrification Business.
    - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  2. 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 - Crimped Pressure-Type Grounding and Bonding Cable 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. ABB, Electrification Business.
  - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. ILSCO.
2. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
  - a. Copper, C and H shaped.

## 2.6 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.

## PART 3 - EXECUTION

### 3.1 SELECTION OF GROUNDING AND BONDING CONDUCTORS

- A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
- B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
- C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
- D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
- E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

- G. Underground Grounding Conductors: Install barecopper conductor, 2/0 AWG minimum.
  - 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.

### 3.2 SELECTION OF CONNECTORS

- A. Conductor Terminations and Connections:
  - 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 Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. 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.
  - 2. Connections: 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) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
3. 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.
4. Equipment Grounding:
- a. Install insulated equipment grounding conductors with feeders and branch circuits.
  - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
    - 1) Feeders and branch circuits.
    - 2) Lighting circuits.
    - 3) Receptacle circuits.
    - 4) Single-phase motor and appliance branch circuits.
    - 5) Three-phase motor and appliance branch circuits.
    - 6) Flexible raceway runs.
    - 7) Armored and metal-clad cable runs.
    - 8) Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
    - 9) X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
  - c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
  - d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
  - e. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

#### A. 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.

B. 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.

3.5 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 260526

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## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Sockets.
  - e. Eye nuts.
  - f. Fasteners.
  - g. Anchors.
  - h. Saddles.
  - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; 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 D635.

#### 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 inch on center in at least one surface.
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. ABB, Electrification Business.
  - b. Allied Tube & Conduit; Atkore International.
  - c. CADDY; brand of nVent Electrical plc.
  - d. Cooper B-line; brand of Eaton, Electrical Sector.
  - e. Flex-Strut Inc.
  - f. G-Strut.
  - g. Gripple Inc.
  - h. Haydon Corporation.
  - i. MIRO Industries.
  - j. Metal Ties Innovation.
  - k. Rocket Rack; Robroy Industries.
  - l. Unistrut; Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Material for Channel, Fittings, and Accessories: Stainless steel, Type 304.
  4. Channel Width: Selected for applicable load criteria.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
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. ABB, Electrification Business.
    - b. Eaton.
    - c. Flex-Strut Inc.
    - d. Haydon Corporation.
    - e. MKT Metal Manufacturing.
    - f. Unistrut; Atkore International.
  2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Channel Material: 6063-T5 aluminum alloy.
  4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
  5. Channel Width: Selected for applicable load criteria.
  6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Conduit and Cable Support Devices: Stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - a. 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) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 2) MKT Fastening, LLC.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 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) Cooper B-line; brand of Eaton, Electrical Sector.
    - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 3) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: Stainless steel springhead type.
7. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA NEIS 101
  2. NECA NEIS 102.
- B. Comply with requirements in Division 7 for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.



- F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT and ERM C may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
  - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 PAINTING

- A. Touchup:
  - 1. 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.

- a. 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 A780.

END OF SECTION 260529

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## SECTION 260533.13 – CONDUITS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Type EMT-S duct raceways and elbows.
2. Type FMC-S and Type FMC-A duct raceways.
3. Type LFMC duct raceways.
4. Type PVC duct raceways and fittings.
5. Fittings for conduit, tubing, and cable.
6. Electrically conductive corrosion-resistant compounds for threaded conduit.
7. Solvent cements.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

#### 1.2 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Type EMT-S duct raceways and elbows.
2. Type FMC-S duct raceways.
3. Type LFMC duct raceways.
4. Type PVC duct raceways and fittings.
5. Fittings for conduit, tubing, and cable.
6. Electrically conductive corrosion-resistant compounds for threaded conduit.
7. Solvent cements.

## PART 2 - PRODUCTS

### 2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

#### A. Performance Criteria:

1. Regulatory Requirements: 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: UL CCN FJMX; including UL 797.

#### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

#### C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

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. American Conduit; Norsk Hydro ASA, Hydro Extrusion USA LLC.
  - b. Patriot Aluminum Products, LLC.
  - c. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway.
2. Options:
  - a. Exterior Coating: Zinc.
  - b. Interior Coating: Zinc.
  - c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
  - d. Colors: As indicated on Drawings.

### 2.2 TYPE FMC-S DUCT RACEWAYS

#### A. Performance Criteria:

1. Regulatory Requirements: 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: UL CCN DXUZ; including UL 1.

#### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):

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. American Conduit; Norsk Hydro ASA, Hydro Extrusion USA LLC.
  - b. Patriot Aluminum Products, LLC.
  - c. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway.
2. Material: Steel.
3. Options:
  - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE LFMC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: 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: UL CCN DXHR; including UL 360.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):

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. ABB, Electrification Business.
  - b. Anaconda Sealtite; Anamet Electrical, Inc.
  - c. Electri-Flex Company.
  - d. International Metal Hose Co.
2. Material: Steel.
3. Options:
  - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: 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: UL CCN DZYR; including UL 651.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

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. ABB, Electrification Business.
- b. Calconduit; Atkore International.
- c. JM Eagle.
- d. NAPCO; Westlake Chemical Corp.
- e. Opti-Com Manufacturing Network, Inc (OMNI).
- f. Topaz Lighting & Electric.

2. Dimensional Specifications: Schedule 40.

3. Options:

- a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
- b. Markings: For use with maximum 90 deg C wire.

## 2.5 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: 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.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2. Listing Criteria: UL CCN EBMB; including UL 1203.

C. UL DWTT - Fittings for Type ERMC and Type PVC Duct Raceways:

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. ABB, Electrification Business.
- b. Appleton; Emerson Electric Co., Automation Solutions.
- c. Crouse-Hinds; brand of Eaton, Electrical Sector.
- d. Konkore Fittings; Atkore International.
- e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

- f. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway.
      - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      - h. Southwire Company, LLC.
      - i. Topaz Lighting & Electric.
    - 2. Listing Criteria: UL CCN DWTT; including UL 514B.
    - 3. Options:
      - a. Material: Steel.
      - b. Coupling Method: Compression coupling.
      - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
  - D. UL FKA V - Fittings for Type EMT Duct Raceways:
    - 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. ABB, Electrification Business.
      - b. Allied Tube & Conduit; Atkore International.
      - c. Appleton; Emerson Electric Co., Automation Solutions.
      - d. Calconduit; Atkore International.
      - e. Crouse-Hinds; brand of Eaton, Electrical Sector.
      - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
      - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      - h. Southwire Company, LLC.
      - i. Topaz Lighting & Electric.
    - 2. Listing Criteria: UL CCN FKA V; including UL 514B.
    - 3. Options:
      - a. Material: Steel.
      - b. Coupling Method: Compression coupling.
      - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- 2.6 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT
- A. Performance Criteria:
    - 1. Regulatory Requirements: 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: UL CCN FOIZ; including UL Subject 2419.
  - B. Source Quality Control:
    - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
  - C. UL FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:



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. ABB, Electrification Business.

## 2.7 SOLVENT CEMENTS

### A. Performance Criteria:

1. Regulatory Requirements: 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: UL CCN DWTT; including UL 514B.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

## PART 3 - EXECUTION

### 3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- #### A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.

#### B. Outdoors:

1. Exposed and Subject to Severe Physical Damage: ERM C.
2. Exposed and Subject to Physical Damage: ERM C.
  - a. Locations less than 2.5 m (8 ft) above finished floor.
3. Exposed and Not Subject to Physical Damage: ERM C.
4. Concealed Aboveground: ERM C.
5. Direct Buried: PVC-40.
6. Concrete Encased Not in Trench: PVC-40.
7. Concrete Encased in Trench: PVC-40.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFM C.

#### C. Indoors:

1. Exposed and Subject to Severe Physical Damage: ERM C. Locations include the following:

- a. Loading docks.
  - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
  - c. Mechanical rooms.
  - d. Gymnasiums.
2. Exposed and Subject to Physical Damage: ERMC. Locations include the following:
- a. Locations less than 2.5 m (8 ft) above finished floor.
  - b. Stub-ups to above suspended ceilings.
3. Exposed and Not Subject to Physical Damage: EMT.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: ERMC.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.
- D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMC: Provide threaded-type fittings unless otherwise indicated.
- 3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS
- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
  2. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
  3. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
  4. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
  5. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
  6. Expansion Fittings: NEMA FB 2.40.
  7. Consult Engineer for resolution of conflicting requirements.
- C. Special Installation Techniques:
1. General Requirements for Installation of Duct Raceways:
    - a. Complete duct raceway installation before starting conductor installation.
    - b. 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.
    - c. Install no more than equivalent of four 90-degree bends in conduit run. Support within 12 inch of changes in direction.
    - d. Make bends in duct 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.
    - e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
    - f. Support conduit within 12 inch of enclosures to which attached.

- g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
  - h. Install devices to seal duct 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 duct raceways at the following points:
    - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    - 2) Where an underground service duct raceway enters a building or structure.
    - 3) Conduit extending from interior to exterior of building.
    - 4) Conduit extending into pressurized duct raceway and equipment.
    - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    - 6) Where otherwise required by NFPA 70.
  - i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
  - j. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
  - k. Keep duct raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
  - l. 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.
  - m. Install pull wires in empty duct 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 duct raceways designated as spare above grade alongside duct raceways in use.
  - n. Install duct 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.
    - 1) Termination fittings with shoulders do not require two locknuts.
  - o. 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.
2. Types ERMC:
- a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
3. Types FMC and LFMC:
- a. Provide a maximum of 36 inch of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
4. Types 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 published instructions for solvent welding and fittings.
5. Stub-ups to Above Recessed Ceilings:
- a. Provide EMT or ERMC for duct raceways.
  - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
6. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
- a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG.
7. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
- a. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
  - b. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
8. Expansion-Joint Fittings:
- a. 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 conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
  - b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
    - 1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - 2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - 3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - 4) Attics: 135 deg F temperature change.
  - c. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  - d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
  - e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

9. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
10. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
  - a. Provide warning signs.

D. Interfaces with Other Work:

1. Coordinate installation of new products with existing conditions.
2. Coordinate with Division 7 for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 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.

END OF SECTION 260533.13

## SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

##### B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

##### B. Shop Drawings:

1. Shop drawings for floor boxes.

### PART 2 - PRODUCTS

#### 2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

##### A. Performance Criteria:

1. Regulatory Requirements: 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: UL CCN QCIT; including UL 514A.

##### B. UL QCIT - Metallic Outlet Boxes and Covers:

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. 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. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Arlington Industries, Inc.
  - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. MonoSystems, Inc.
  - i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - j. Pass & Seymour; Legrand North America, LLC.
  - k. Patriot Aluminum Products, LLC.
  - l. Plasti-Bond; Robroy Industries.
  - m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - n. Spring City Electrical Manufacturing Company.
  - o. Topaz Lighting & Electric.
  - p. Wiremold; Legrand North America, LLC.

3. Options:

- a. Material: Sheet aluminum.
- b. Sheet Metal Depth: Minimum 2.5 inch.
- c. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

C. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
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. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - f. Pass & Seymour; Legrand North America, LLC.
  - g. Patriot Aluminum Products, LLC.
  - h. Plasti-Bond; Robroy Industries.
  - i. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - j. Topaz Lighting & Electric.

D. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to 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. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Arlington Industries, Inc.
  - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - i. Patriot Aluminum Products, LLC.
  - j. Plasti-Bond; Robroy Industries.
  - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - l. Topaz Lighting & Electric.
3. Options:
  - a. Material: Sheet aluminum.
  - b. Sheet Metal Depth: minimum 2.5 inch.

E. UL QCIT - Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

2.2 NONMETALLIC 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. Listing Criteria: UL CCN QCMZ; including UL 514C.

B. UL QCMZ - Nonmetallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or 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. 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. ABB, Electrification Business.
  - b. Allied Tube & Conduit; Atkore International.
  - c. Appleton; Emerson Electric Co., Automation Solutions.
  - d. Arlington Industries, Inc.
  - e. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - f. Cantex Inc.



- g. Crouse-Hinds; brand of Eaton, Electrical Sector.
- h. Ericson Manufacturing Company.
- i. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- j. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- k. Intermatic, Inc.
- l. JM Eagle.
- m. Leviton Manufacturing Co., Inc.
- n. Panduit Corp.
- o. Pass & Seymour; Legrand North America, LLC.
- p. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- q. Topaz Lighting & Electric.
- r. Wiremold; Legrand North America, LLC.

C. UL QCMZ - Nonmetallic Conduit Bodies:

- 1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

D. UL QCMZ - Nonmetallic Device Boxes:

- 1. Description: Box with provisions for mounting wiring device directly to box.

E. UL QCMZ - Nonmetallic Extension Rings:

- 1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

## 2.3 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. UL BGUZ - 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. 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. Adalet.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Cooper B-line; brand of Eaton, Electrical Sector.
  - d. FSR Inc.
  - e. Hoffman; brand of nVent Electrical plc.
  - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

- g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- h. Milgard Manufacturing, LLC.
- i. N J Sullivan Company.
- j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
- k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- l. Spring City Electrical Manufacturing Company.
- m. Square D; Schneider Electric USA.

3. Options:

- a. Degree of Protection: Type 1.

C. UL BGUZ - 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. 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. Adalet.
- b. Appleton; Emerson Electric Co., Automation Solutions.
- c. Cooper B-line; brand of Eaton, Electrical Sector.
- d. FSR Inc.
- e. Hoffman; brand of nVent Electrical plc.
- f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- h. Milgard Manufacturing, LLC.
- i. N J Sullivan Company.
- j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
- k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- l. Spring City Electrical Manufacturing Company.
- m. Square D; Schneider Electric USA.

3. Options:

- a. Degree of Protection: Type 3R.

2.4 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
- 3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

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. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Intermatic, Inc.
  - h. Leviton Manufacturing Co., Inc.
  - i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - j. Panduit Corp.
  - k. Pass & Seymour; Legrand North America, LLC.
  - l. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - m. Topaz Lighting & Electric.
  - n. Wiremold; Legrand North America, LLC.
2. Options:
  - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
  - b. Wallplate Material: 0.040 inch thick aluminum, anodized or lacquered to prevent corrosion.

## PART 3 - EXECUTION

### 3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published 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. Type 3R unless otherwise indicated.
  2. Indoors:
    - a. Type 1 unless otherwise indicated.
    - b. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
- C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
  1. Boxes with knockouts or unprotected openings are prohibited.

2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

### 3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
  1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
  2. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
  1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
  2. Mount boxes at heights indicated on Drawings. 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.
  3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. 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.
  4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  5. Locate boxes so that cover or plate will not span different building finishes.
  6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
  7. 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.
  8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
  9. Set metal floor boxes level and flush with finished floor surface.
  10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
  11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
  12. 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.
  13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
    - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    - b. Provide gaskets for wallplates and covers.
  14. Identification: Provide labels for boxes and associated electrical equipment.
    - a. Identify field-installed conductors, interconnecting wiring, and components.
    - b. Provide warning signs.
    - c. Label each box with engraved metal or laminated-plastic nameplate.
- D. Interfaces with Other Work:

1. Coordinate installation of new products for with existing conditions.

### 3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

### 3.4 PROTECTION

- A. After installation, protect boxes 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 260533.16

## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Type PVC raceways and fittings.
2. Fittings for conduit, tubing, and cable.
3. Solvent cements.
4. Duct accessories.
5. Handholes and boxes for exterior underground wiring.
6. Duct sealing.

B. Related Requirements:

1. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).

#### 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.

#### 1.4 ACTION SUBMITTALS

A. Product Data:

1. Type PVC raceways and fittings.
2. Fittings for conduit, tubing, and cable.
3. Duct accessories.
4. Handholes and boxes for exterior underground wiring.
5. Duct sealing.

B. Shop Drawings:

1. 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 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. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

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. ABB, Electrification Business.
  - b. Calconduit; Atkore International.
  - c. JM Eagle.
  - d. NAPCO; Westlake Chemical Corp.
  - e. Opti-Com Manufacturing Network, Inc (OMNI).
  - f. Topaz Lighting & Electric.
2. Dimensional Specifications: Schedule 40.
3. Options:
  - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
  - b. Markings: For use with maximum 90 deg C wire.

2.2 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.

## 2.3 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.
  - 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. ABB, Electrification Business.
    - b. Allied Tube & Conduit; Atkore International.
    - c. Cantex Inc.
    - d. IPEX USA LLC.
    - e. PenCell Plastics; brand of Hubbell Utility Solutions; Hubbell Incorporated.
    - f. Underground Devices, Inc.
- B. Underground-Line Warning Tape: In accordance with Section 260553 "Identification for Electrical Systems."
- C. Concrete Warning Planks: Nominal 12 by 24 by 3 inch in size, manufactured from 6000 psi concrete.
  - 1. Color: Red dye added to concrete during batching.
  - 2. Mark each plank with "ELECTRIC" in 2 inch high, 3/8 inch deep letters.

## 2.4 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. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. NewBasis.
    - b. Oldcastle Infrastructure Inc.; CRH Americas.
    - c. Quazite; brand of Hubbell Utility Solutions; Hubbell Incorporated.
  - 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".
5. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.
  6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged 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 or Green to match installation area.

## 2.5 SOURCE QUALITY CONTROL

- A. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
  1. Duct-bank materials, including spacers and miscellaneous components.
  2. Ducts, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  3. Underground-line warning tape.
- B. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- C. Factory Tests for Handholes and Boxes:
  1. Testing Administrant: Engage qualified structural testing agency to evaluate handholes and boxes.
    - a. Tests of materials must be performed by independent testing agency.
    - b. Strength tests of complete boxes and covers must be by independent testing agency or manufacturer. Qualified registered professional engineer must certify tests by manufacturer.
  2. Factory Tests and Inspections: Perform the following tests and inspections on handholes and boxes, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of manufacturer's certification of system compliance.
    - a. Precast Concrete Utility Structures: Test and inspect in accordance with ASTM C1037.
    - b. Polymer Concrete and Nonconcrete Handhole and Pull-Box Prototypes: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests must be for specified tier ratings of products supplied. Testing machine pressure gages must have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.
  3. Nonconforming Work:
    - a. Equipment that does not pass tests and inspections will be considered defective.

4. Factory Test Reports: Prepare and submit factory test and inspection reports.

## 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 Division 3. Remove and stockpile topsoil for reapplication in accordance with Division 3.

### 3.2 SELECTION OF UNDERGROUND DUCTS

- A. Duct for Electrical Branch Circuits: PVC-40, direct buried unless otherwise indicated.
- B. Underground Ducts Crossing Paved Paths Walks: PVC-40 direct buried.

### 3.3 SELECTION OF UNDERGROUND ENCLOSURES

- A. Handholes and Boxes:
  1. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 15 structural load rating.
  2. Cover design load must not exceed load rating of handhole or box.

### 3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Division 3, but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Restore area immediately after backfilling is completed.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 3.
- E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures in accordance with "Cutting and Patching" Article in Division 1.

### 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. 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.
3. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.
4. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch.
5. 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 270 degrees of bends between pull points.
6. 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.
7. 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.
8. Pulling Cord: Install 200 lbf test nylon cord in empty ducts.
9. Direct-Buried Duct and Duct Bank:
  - a. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Division 3 for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
  - b. Width: Excavate trench 3 inch wider than duct on each side.
  - c. Depth: Install top of duct at least 24 inch below finished grade unless otherwise indicated.
  - d. Set elevation of top of duct bank below frost line.

- e. Place minimum 3 inch of sand as bed for duct. Place sand to minimum of 6 inch above top level of duct.
  - f. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - g. 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 ducts 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.
  - h. Install duct with minimum of 3 inch between ducts for like services and 6 inch between power and communications duct.
  - i. Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  - j. Install manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct.
    - 1) Couple RNC duct to steel raceway with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete.
    - 2) Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally on exterior of wall minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.
  - k. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Division 3 for installation of backfill materials.
10. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "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.
11. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

#### A. 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, below grade.
5. 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.
6. 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.
  - a. Concrete: 3000 psi, 28-day strength, complying with Division 3, with troweled finish.
  - b. Dimensions: 10 inch wide by 12 inch deep.
7. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by Tenant.
- 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.
- 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.

### 3.8 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 260543

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Round sleeves.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Foam sealants.

##### B. Related Requirements:

1. Division 7 for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.2 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 ROUND SLEEVES

##### A. Steel Wall Sleeves:

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. Advance Products & Systems, LLC.
  - b. CCI Piping Systems.
  - c. Flexicraft Industries.
  - d. GPT; an EnPro Industries company.
2. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

##### B. PVC Pipe Sleeves:

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. CCI Piping Systems.
  - b. GPT; an EnPro Industries company.

- c. Metraflex Company (The).
  2. General Characteristics: ASTM D1785, Schedule 40.
- C. Round, Galvanized-Steel, Sheet Metal Sleeves:
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. Benefast.
    - b. Specified Technologies, Inc.
  2. 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 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, LLC.
  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: Nitrile (Buna N) 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.

## 2.3 SLEEVE-SEAL FITTINGS

- 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. Holdrite; a division of Reliance Worldwide Corporation.
- B. 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.

## 2.4 GROUT

- 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. W. R. Meadows, Inc.
- B. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
1. Standard: ASTM C1107/C1107M, 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.

## 2.5 FOAM SEALANTS

- 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. Innovative Chemical Products (Building Solutions Group).
  2. The Dow Chemical Company.
- B. 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 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
    - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7.
  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 system 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.



5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

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

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

### 3.2 INSTALLATION OF SLEEVE-SEAL SYSTEMS

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 260544

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Labels.
  2. Bands and tubes.
  3. Tapes and stencils.
  4. Tags.
  5. Signs.
  6. Cable ties.
  7. Miscellaneous identification products.

#### 1.2 ACTION SUBMITTALS

- A. Product Data:
1. Labels.
  2. Bands and tubes.
  3. Tapes and stencils.
  4. Tags.
  5. Signs.
  6. Cable ties.
  7. Miscellaneous identification products.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
1. Fire-protection equipment, including raceways, must be finished, painted, or suitably marked safety red.
  2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
1. Safety Colors: NEMA Z535.1.
  2. Facility Safety Signs: NEMA Z535.2.
  3. Safety Symbols: NEMA Z535.3.
  4. Product Safety Signs and Labels: NEMA Z535.4.
  5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- E. 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. Raceways and Cables Carrying Circuits at 1000 V or Less:
  - 1. Black letters on orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
  - 2. Colors for 240 V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 3. Colors for 480Y/277 V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 4. Color for Neutral: White.
  - 5. Color for Equipment Grounds: Green.
  - 6. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 1000 V:
  - 1. Black letters on orange field.
  - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
  - 1. Identify system voltage with black letters on orange background.
- E. Warning labels and signs must include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
- F. Equipment Identification Labels:
  - 1. Black letters on white field.

## 2.3 LABELS

- A. Self-Adhesive Wraparound Labels: Write-on, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
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'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. Grafoplast Wire Markers.
    - e. Ideal Industries, Inc.
    - f. LEM Products Inc.
    - g. Marking Services Inc.
    - h. Panduit Corp.
    - i. Seton Identification Products; a Brady Corporation company.
    - j. emedco.
  2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
  3. Marker for Labels:
    - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.

## 2.4 BANDS AND TUBES

- A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.
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. Panduit Corp.

## 2.5 TAPES AND STENCILS

- A. self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
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.
    - d. emedco.

- B. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.
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. HellermannTyton.
    - b. LEM Products Inc.
    - c. Marking Services Inc.
    - d. Pipemarket.com; Brimar Industries, Inc.
    - e. Seton Identification Products; a Brady Corporation company.
- C. Floor Marking Tape: 2 inch wide, 5 mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
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. Seton Identification Products; a Brady Corporation company.
- D. 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. LEM Products Inc.
    - d. Marking Services Inc.
    - e. Pipemarket.com; Brimar Industries, Inc.
    - f. Reef Industries, Inc.
    - g. Seton Identification Products; a Brady Corporation company.
  2. Tape:
    - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical utility lines.
    - b. Printing on tape must be permanent and may not be damaged by burial operations.
    - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  3. Color and Printing:
    - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
    - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
  4. Tape:

- a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, compounded for direct-burial service.
  - b. Width: 3 inch.
  - c. Overall Thickness: 5 mil.
  - d. Foil Core Thickness: 0.35 mil.
  - e. Weight: 28 lb/1000 sq. ft.
  - f. Tensile in accordance with ASTM D882: 70 lbf and 4600 psi.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

## 2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
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.
    - d. Seton Identification Products; a Brady Corporation company.
    - e. emedco.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.
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. Grafoplast Wire Markers.
    - d. LEM Products Inc.
    - e. Marking Services Inc.
    - f. Panduit Corp.
    - g. Seton Identification Products; a Brady Corporation company.
    - h. emedco.
- C. Write-on Tags:
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. LEM Products Inc.
    - c. Pipemarket.com; Brimar Industries, Inc.
    - d. Seton Identification Products; a Brady Corporation company.

2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:
  - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.

## 2.7 SIGNS

### A. Baked-Enamel 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. Carlton Industries, LP.
  - b. Champion America.
  - c. Marking Services Inc.
  - d. emedco.
2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inch.

### B. 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.
  - d. emedco.
2. Engraved legend.
3. Thickness:
  - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
  - b. For signs larger than 20 sq. inch, 1/8 inch thick.
  - c. Engraved legend with black letters on white face.
  - d. Self-adhesive.
  - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 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 in accordance with ASTM D638: 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 F in accordance with ASTM D638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 9 for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

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 item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- K. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- L. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- M. Self-Adhesive Labels:
  - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide 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 inch high.
- N. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- P. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- Q. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- R. Tape and Stencil: Comply with requirements in Division 9 for surface preparation and paint application.
- S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- T. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
  2. Limit use of underground-line warning tape to direct-buried cables.
  3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- U. Metal Tags:
1. Place in location with high visibility and accessibility.
  2. Secure using UV-stabilized cable ties.
- V. Nonmetallic Preprinted Tags:
1. Place in location with high visibility and accessibility.
  2. Secure using UV-stabilized cable ties.
- W. Write-on Tags:
1. Place in location with high visibility and accessibility.
  2. Secure using UV-stabilized cable ties.
- X. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
  2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on minimum 1-1/2 inch high sign; where two lines of text are required, use signs minimum 2 inch high.
- Y. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
  2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.
- Z. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
  2. In Spaces Handling Environmental Air: Plenum rated.

### 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. Concealed Raceways, Duct Banks, More Than 1000 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3 inch high, black letters on 20 inch centers.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10 ft maximum intervals.
- D. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- E. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- F. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify phase.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- G. Power-Circuit Conductor Identification, More Than 1000 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and separate tag with circuit designation.
- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Concealed Raceways and Duct Banks, More Than 1000 V, within Buildings: Apply floor marking tape to the following finished surfaces:
  - 1. Floor surface directly above conduits running beneath and within 12 inch of floor that is in contact with earth or is framed above unexcavated space.
  - 2. Wall surfaces directly external to raceways concealed within wall.
  - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in building, or concealed above suspended ceilings.
- J. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70

and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- K. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- M. Arc Flash Warning Labeling: Self-adhesive labels.
- N. Operating Instruction Signs: Self-adhesive labels.
- O. Equipment Identification Labels:
  - 1. Indoor Equipment: Baked-enamel signs.
  - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
  - 3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchboards.
    - e. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
    - f. Substations.
    - g. Enclosed switches.
    - h. Enclosed circuit breakers.

END OF SECTION 260553

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## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Indoor occupancy and vacancy sensors.
2. Switchbox-mounted occupancy sensors.
3. Conductors and cables.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Indoor occupancy and vacancy sensors.
2. Switchbox-mounted occupancy sensors.
3. Conductors and cables.

B. Shop Drawings:

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

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. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
3. Intermatic, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.

6. Lutron Electronics Co., Inc.
7. RAB Lighting.
8. Sensor Switch, Inc.
9. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor occupancy sensors.
2. Dual technology.
3. Separate power pack.
4. Hardwired connection to switch.
5. 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.
6. Operation:
  - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
10. Mounting:
  - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
  - b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 sq. ft. when mounted 48 inch above finished floor.

## 2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- 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. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  3. Intermatic, Inc.
  4. Leviton Manufacturing Co., Inc.
  5. Lithonia Lighting; Acuity Brands Lighting, Inc.
  6. Lutron Electronics Co., Inc.
  7. RAB Lighting.
  8. Sensor Switch, Inc.
  9. WattStopper; Legrand North America, LLC.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
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. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
  4. Switch Rating: Not less than 800 VA LED load at 120 V, 1200 VA LED load at 277 V, and 800 W incandescent.
- C. Wall-Switch Sensor:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
  2. Sensing Technology: Dual technology - PIR and ultrasonic.
  3. Switch Type: SP.
  4. Capable of controlling load in three-way application.
  5. Voltage: Match the circuit voltage.
  6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
  8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
  9. Color: White.
  10. Faceplate: Color matched to switch.

## 2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."



- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## 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 SENSORS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

### 3.3 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- 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 260553 "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.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

END OF SECTION 260923

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## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with ground-fault protective devices.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

#### 1.2 DEFINITIONS

A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.

B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with ground-fault protective devices.

B. Shop Drawings:

1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Items: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Extra Keys for Key Lock Switches: One of each kind.

B. Special Tools:

1. Proprietary equipment and software required to maintain, repair, adjust, or implement future changes to controlled receptacles.

2. Proprietary equipment required to maintain, repair, adjust, or implement future changes to cord connectors.

## 1.5 WARRANTY FOR DEVICES

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.
  1. Initial Extended Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

## PART 2 - PRODUCTS

### 2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

- A. Toggle Switch :
  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. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Leviton Manufacturing Co., Inc.
    - d. Pass & Seymour; Legrand North America, LLC.
  2. 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.
  3. General Characteristics:
    - a. Reference Standards: UL CCN WMUZ and UL 20.
  4. Options:
    - a. Device Color: Black.
    - b. Configuration:
      - 1) General-duty, 120-277 V, 20 A, single pole & three way.
  5. Accessories:
    - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
    - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

## 2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

### A. Duplex Straight-Blade Receptacle:

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. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
2. 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.
3. General Characteristics:
  - a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
  - a. Device Color: Black.
  - b. Configuration:
    - 1) General-duty, NEMA 5-20R.
5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

## 2.3 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

### A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device :

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. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
2. 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.
  3. General Characteristics:
    - a. Reference Standards: UL CCN KCXX, UL 498, UL 943, UL 1699, and UL Subject 1699A.
  4. Options:
    - a. Device Color: Black.
    - b. Configuration: Heavy-duty, NEMA 5-20R.
  5. Accessories:
    - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
    - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- B. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
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. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Leviton Manufacturing Co., Inc.
    - d. Pass & Seymour; Legrand North America, LLC.
  2. 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.
  3. General Characteristics:
    - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
  4. Options:
    - a. Device Color: Black.
    - b. Configuration: Heavy-duty, NEMA 5-20R.
  5. Accessories:
    - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
    - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

## 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 INSTALLATION OF SWITCHES

#### A. Comply with manufacturer's instructions.

#### B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

#### C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

### 3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

#### A. Comply with manufacturer's instructions.

#### B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

#### C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

### 3.4 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.

### 3.5 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.
  - 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.
  - 1. inspections.

### 3.6 ADJUSTING

- A. Occupancy Adjustments for Controlled Receptacles: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.7 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.
  - 2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates 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 262726

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Enclosures.

#### 1.2 DEFINITIONS

- A. GFEP: Ground-fault circuit-interrupter for equipment protection.
- B. GFLS: Ground-fault circuit-interrupter for life safety.
- C. SPDT: Single pole, double throw.

#### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 2. Enclosure types and details for types other than UL 50E, Type 1.
  - 3. Current and voltage ratings.
  - 4. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  2. Fuse Pullers: Two for each size and type.

1.6 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: 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.

2.2 FUSIBLE SWITCHES

- 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. ABB, Electrification Business.
  2. Eaton.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
1. Single throw.
  2. Three pole.
  3. 600 V(ac).
  4. 200 A and smaller.

5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Hookstick Handle: Allows use of hookstick to operate handle.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

### 2.3 NONFUSIBLE SWITCHES

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. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Hookstick Handle: Allows use of hookstick to operate handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

### 2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: Enclosure must be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).

C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: Circuit-breaker operating handle must be externally operable with operating mechanism being integral part of box, not cover. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism,

which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

- E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.
- F. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

### 3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.

### 3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
  - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
  - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
  - 3. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
  - 4. Install fuses in fusible devices.

### 3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.5 FIELD QUALITY CONTROL

#### A. Tests and Inspections for Switches:

##### 1. Visual and Mechanical Inspection:

- a. Inspect physical and mechanical condition.
- b. Inspect anchorage, alignment, grounding, and clearances.
- c. Verify that unit is clean.
- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- e. Verify that fuse sizes and types match the Specifications and Drawings.
- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the following methods:
  - 1) Use low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

##### 2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- c. 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. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

- B. Nonconforming Work:
  - 1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- C. Collect, assemble, and submit test and inspection reports.
  - 1. Test procedures used.
  - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

### 3.7 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers 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.

### 3.8 MAINTENANCE

- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
  - 1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
  - 3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
  - 4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262816

## SECTION 265119 - LED 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 SUMMARY

- A. Section Includes:

1. Suspended, nonlinear.
2. Materials.
3. Luminaire support.

- B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 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. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Arrange in order of luminaire designation.
  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.



- B. 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.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 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. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

#### 1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
  - 1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
  - 2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- 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.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

#### 1.9 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: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
  - 1. Luminaires and lamps shall be labeled vibration and shock resistant.
- B. Ambient Temperature: 41 to 104 deg F.
  - 1. Relative Humidity: Zero to 95 percent.
- C. 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. 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.

### 2.3 SUSPENDED, NONLINEAR

- 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. Cooper Lighting Solutions; Signify North America Corp.
  - 2. Focal Point; Legrand North America, LLC.
  - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Nominal Operating Voltage: 120 V ac.
- C. Lamp:
  - 1. Minimum 4,000 lm.
  - 2. Minimum allowable efficacy of 85 lm/W.
  - 3. CRI of minimum 80. CCT of 4000 K.
  - 4. Rated lamp life of 50,000 hours to L70.
  - 5. Dimmable from 100 percent to zero percent of maximum light output.

6. Internal driver.
7. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear powder-coat finish.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:

1. Prismatic acrylic.
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

G. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.

## 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. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

## 2.5 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.

## 2.6 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Wires: ASTM A641/A641M, 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 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. 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 lamps in each luminaire.
- D. 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.
- E. 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.

F. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. 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.

G. Comply with requirements in Section 260519 "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 260553 "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.
2. 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.

### 3.6 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.

END OF SECTION 265119

## SECTION 265213 - 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. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
  - 1. Include data on features, accessories, and finishes.
  - 2. Include physical description of the unit and dimensions.
  - 3. Battery and charger for light units.
  - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    - a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.
    - b. 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.

- B. Shop Drawings: For nonstandard or custom luminaires.
  - 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. Include diagrams for power, signal, and control wiring.
- C. Samples: For each product and for each color and texture specified.
- D. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.
- E. Samples for Verification: For each type of luminaire.
  - 1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule:
  - 1. For emergency lighting units. Use same designations indicated on Drawings.
  - 2. For exit signs. Use same designations indicated on Drawings.

#### 1.5 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 will be attached.
  - 5. Size and location of initial access modules for acoustical tile.
  - 6. Items penetrating finished ceiling including the following:
    - a. Other luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Ceiling-mounted projectors.
    - e. Sprinklers.
    - f. Access panels.
  - 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Product Certificates: For each type of luminaire.
- D. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  4. Provide seismic qualification certificate for each piece of equipment.
- E. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Sample Warranty: For manufacturer's special warranty.

#### 1.6 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.

#### 1.7 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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Luminaire-mounted, emergency battery pack: One for every 50 emergency lighting units. 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. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

#### 1.8 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. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
1. Obtain Architect's approval of luminaires and signs in mockups before starting installations.
  2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.



3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

#### 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. Warranty Period: Two year(s) from date of Substantial Completion.

- 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 the entire warranty period.
2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six years the entire warranty period.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

#### 2.2 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. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
  - 1. Emergency Connection: Operate one lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
  - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    - c. Humidity: More than 95 percent (condensing).
    - d. Altitude: Exceeding 3300 feet.
  - 4. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
  - 5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 6. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - 7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  - 8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  - 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- I. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
  - 1. Emergency Connection: Operate one LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.

2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type.
6. 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.
7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
10. 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.

## 2.3 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
  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. Amerlux.
    - b. Architectural Lighting Works.
    - c. Cooper Lighting, an Eaton business.
    - d. Dual-Lite.
    - e. GE Lighting Solutions.
    - f. Juno Lighting Group by Schneider Electric.
    - g. Lightolier; a Philips group brand.
    - h. Lithonia Lighting; Acuity Brands Lighting, Inc.
    - i. Philips Lighting Company.
  2. Emergency Luminaires: as indicated on Drawings, with the following additional features:
    - a. Operating at nominal voltage of 120 V ac.
    - b. Internal emergency power unit.
    - c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
    - d. UL 94 5VA flame rating.
- C. Emergency Lighting Unit:

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. Amerlux.
  - b. Architectural Lighting Works.
  - c. Cooper Lighting, an Eaton business.
  - d. Dual-Lite.
  - e. Evenlite, Inc.
  - f. GE Lighting Solutions.
  - g. Lighting Services, Inc.
  - h. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - i. Ruud Lighting Direct.
2. Emergency Lighting Unit: as indicated on Drawings.
3. Operating at nominal voltage of 120 V ac.
4. Wall with universal junction box adaptor.
5. UV stable thermoplastic housing, rated for damp locations.
6. Two LED lamp heads.
7. Internal emergency power unit.

D. Remote Emergency Lighting Units:

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. Cooper Lighting, an Eaton business.
  - b. GE Lighting Solutions.
  - c. Hubbell Industrial Lighting; Hubbell Incorporated.
  - d. Juno Lighting Group by Schneider Electric.
  - e. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - f. Philips Lighting Company.
2. Emergency Lighting Unit: as indicated on Drawings.
3. Operating at nominal voltage of 120 V ac.
4. Wall with universal junction box adaptor.
5. UV stable thermoplastic housing, rated for damp locations.
6. Two LED lamp heads.
7. External emergency power unit.

2.4 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. Internally Lighted 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. Amerlux.
    - b. Cooper Lighting, an Eaton business.
    - c. Evenlite, Inc.

- d. Hubbell Industrial Lighting; Hubbell Incorporated.
  - e. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - f. Philips Lighting Company.
  - g. Ruud Lighting Direct.
- 2. Operating at nominal voltage of 120 V ac.
  - 3. Lamps for AC Operation: Fluorescent, two for each luminaire; 20,000 hours of rated lamp life.
  - 4. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
  - 5. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
  - 6. Master/Remote Sign Configurations:
    - a. Master Unit: Comply with requirements above for self-powered exit signs and provide additional capacity in LED power supply and battery for power connection to remote unit.
    - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

## 2.5 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.

### C. Diffusers and Globes:

- 1. Clear, UV-stabilized acrylic.
- 2. Glass: Annealed crystal glass unless otherwise indicated.
- 3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- 4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

### D. Housings:

- 1. Extruded aluminum housing and heat sink.
- 2. Clear powder coat finish.

### E. Conduit: Rigid galvanized steel, minimum 3/4 inch in diameter.

## 2.6 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.

## 2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A641/A641M, 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. Install lamps in each luminaire.
- D. 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.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.

F. 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. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. 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 260553 "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.

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 265213



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## SECTION 265619 - LED 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 solid-state luminaires that are designed for and exclusively use LED lamp technology.
- 2. Luminaire supports.
- 3. Luminaire-mounted photoelectric relays.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 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. 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, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79.

- a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
  - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
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.
- B. 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.
- C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, 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. Structural members to which equipment and luminaires will be attached.
  3. Underground utilities and structures.
  4. Existing underground utilities and structures.
  5. Above-grade utilities and structures.
  6. Existing above-grade utilities and structures.
  7. Building features.
  8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
1. Luminaire.
  2. Photoelectric relay.

- E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Source quality-control reports.
- G. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
  - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

#### 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. 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. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

#### 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- F. Mockups: For exterior luminaires, complete with power and control connections.
  - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

#### 1.10 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.

#### 1.11 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: 2 year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

#### 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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of minimum 80. CCT of 4100 K.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac.
- L. In-line Fusing: On the primary for each luminaire.
- M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- N. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

### 2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- 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. Atlas Lighting Products.
  - 2. Cooper Lighting, an Eaton business.
  - 3. Eaton.
  - 4. GE Lighting Solutions.
  - 5. Intelligent Illuminations, Inc.
  - 6. Intermatic, Inc.
  - 7. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 8. Philips Lighting Company.
  - 9. Schneider Electric USA, Inc.
  - 10. Siemens Industry, Inc., Building Technologies Division.
- B. Comply with UL 773 or UL 773A.
- C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
  - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
  - 2. Adjustable window slide for adjusting on-off set points.

## 2.4 LUMINAIRE TYPES

### A. Area and Site:

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. Architectural Area Lighting.
  - b. Atlas Lighting Products.
  - c. Cooper Lighting, an Eaton business.
  - d. Deco Lighting.
  - e. Gallium Lighting, LLC.
  - f. GE Lighting Solutions.
  - g. H.E. Williams.
  - h. Howard Lighting Products.
  - i. INITIAL-LED.
  - j. KIM Lighting.
  - k. Lightolier; a Philips group brand.
  - l. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - m. RAB Lighting.
2. Luminaire Shape: Round.
3. Mounting: Building Insert mounting type with extruded-aluminum rectangular arm, 13 inches in length.
4. Luminaire-Mounting Height: As indicated on Drawings.
5. Distribution: Type IV.
6. Diffusers and Globes: Prismatic acrylic.
7. Housings:
  - a. Extruded-aluminum housing and heat sink.
  - b. Clear powder-coat finish.

## 2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. 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. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- G. 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.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. 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 specific lamp type.
    - b. Lamp diameter, shape, size, wattage and coating.
    - c. CCT and CRI for all luminaires.

## 2.6 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.
- C. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As selected by Architect from manufacturer's full range.

## 2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "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, for suitable conditions where luminaires will be installed.
- 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 substantially complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 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. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. 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.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- I. Coordinate layout and installation of luminaires with other construction.
- J. 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.

- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections and wiring methods.

### 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 260533.13 Conduits 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 260553 "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 with the assistance of a factory-authorized service representative:
  - 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. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
    - a. IES LM-5.
    - b. IES LM-50.
    - c. IES LM-52.
    - d. IES LM-64.
    - e. IES LM-72.
  - 2. 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 standards.

3.7 DEMONSTRATION

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

3.8 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.

END OF SECTION 265619

## SECTION 283111 - DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This section covers the renovation of City of Philadelphia Recreation center as noted in the plans and specifications for the modification of the existing fire alarm system.
  - 1. Christy Recreational Center. 728 South 55<sup>th</sup> St. Philadelphia, PA 19143.
- B. Section Includes:
  - 1. Fire alarm control panel (relocation).
  - 2. Duct smoke detectors.
  - 3. System smoke detectors.
  - 4. Notification appliances.
- C. This Design Package is not meant to provide final quantities as they are diagrammatical and show the intent of the Owners request for a fully installed and fully operational system. All final quantities of all required parts and pieces to provide said complete system are solely the responsibility of the electrical contractor under this contract, and shall be represented fully on the shop drawings.
  - 1. Furnish and install all conduits, fittings, outlets, junction boxes, supports, hangers, wire and cable and other items incidental to and/or required to complete the installation, in accordance with the intent of the drawings and specifications. This shall include wire and conduit required to operate both new and existing equipment circuits during each phase of the work.
  - 2. Final quantities of fire alarm field devices shall be coordinated between the Electrical Contractor and the Fire Alarm Contractor.
  - 3. All 120VAC circuits required to power all panels and or enclosures as coordinated above shall be included in this scope of work. This information shall be submitted in its entirety to the consulting engineer as part of the Shop Drawing package.
  - 4. Failure to coordinate and include any part or piece required to provide an entirely complete and functioning fire alarm system prior to bid shall not be subject to a change order, and shall be borne solely of this contract.

#### 1.3 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

#### 1.4 REFERENCES AND REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

- A. Codes and Standards: The fire alarm equipment and installation shall conform to the requirements of all applicable codes, rules, regulations, and standards being enforced by agencies having jurisdiction. Codes, rules, regulations, and standards shall be latest version to date or version being enforced by the local approving agencies or code official(s), including, but not limited to, the following:
1. International Code Council (ICC)
    - a. International Building Code
    - b. International Fire Code
    - c. International Mechanical Code.
  2. National Fire Protection Association (NFPA)
    - a. NFPA 13 – Standard for the Installation of Sprinkler Systems
    - b. NFPA 70 – National Electrical Code
    - c. NFPA 72 – National Fire Alarm and Signaling Code
    - d. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems
    - e. NFPA 720 – Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment
  3. FM Global/Factory Mutual (FM)
    - a. Factory Mutual Approval Guide
  4. Underwriters Laboratories (UL)
    - a. UL 38 – Standard for Manual Signaling Boxes for Fire Alarm Systems
    - b. UL 268 – Smoke Detectors for Fire Alarm Systems
    - c. UL268A – Standard for Smoke Detectors for Duct Application
    - d. UL 464 – Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
    - e. UL 486A/B – Wire Connectors
    - f. UL 521 – Standard for Heat Detectors for Fire Protective Signaling Systems
    - g. UL 864 – Standard for Control Units and Accessories for Fire Alarm Systems
    - h. UL 1449 – Standard for Surge Protective Devices
    - i. UL 1971 – Standard for Signaling Devices for the Hearing Impaired
    - j. UL 2034 – Standard for Single and Multiple Station Carbon Monoxide Alarms
    - k. UL 2075 – Standard for Gas and Vapor Detectors and Sensors
    - l. UL Electrical Construction Equipment Directory
    - m. UL Fire Protection Equipment Directory
  5. IEEE Standards Association (IEEE)
    - a. IEEE C62.41.1 – Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits
    - b. IEEE C62.41.2 – Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
    - c. IEEE 1100 - IEEE Recommended Practice for Powering and Grounding Electronic Equipment
  6. National Electrical Manufacturers Association (NEMA)
    - a. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

7. American National Standards Institute (ANSI)
  - a. ANSI S1.4: Specifications for Sound Level Meters
8. United States Department of Justice
  - a. Americans with Disabilities Act (ADA)
  - b. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
9. National Institute for Certification in Engineering Technologies (NICET)
  - a. Fire Alarm Systems Certification
  - b. Inspection & Testing of Fire Alarm Systems

#### 1.5 SYSTEM DESCRIPTION

- A. General: System shall be a complete, supervised, noncoded, addressable system fire alarm system with multiplexed signal transmission dedicated to fire alarm service only. System shall conform to NFPA 72. The System shall have automatic sensitivity control of certain smoke detectors. The system shall have Style 4 Class B circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.

#### 1.6 SUBMITTALS

- A. General Submittal Requirements:
  1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
  2. The fire alarm equipment distributor shall submit, in accordance with Division 1 requirements, documentation as specified in the Quality Assurance portion of this Section. When the distributor intends to utilize the services of a manufacture-affiliated company in the system design, the distributor shall submit a letter of intent to do so, addressed to the Architect, which includes the name of the manufacturer-affiliated company, the names and qualifications of the NICET-certified employees of the company, and which describes the delegation of fire alarm system design responsibilities.
  3. 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 III minimum.
    - c. Licensed or certified by authorities having jurisdiction.
    - d. Drawings and Calculations to be sealed by a registered Professional Engineer in Pennsylvania.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.

2. Provide point-to-point wiring diagrams showing the points of connection and terminals used for all electrical field connections in the system, including all interconnections between the equipment or systems which are supervised or controlled by the system. Diagrams shall show all connections from field devices to the FACP and remote fire alarm control units, initiating circuits, switches, relays and terminals. Provide isometric drawing showing device locations, terminal cabinet locations, and all circuit layouts for all floors. Submit shop drawings not smaller than 30 inches by 42 inches. Shop drawings shall be prepared on a Computer Aided Drafting (CAD) system.
3. Provide a complete description of the system operation.
4. Provide a complete list of devices, device addresses, and corresponding messages.
5. Include voltage drop calculations for notification appliance circuits.
6. Include battery-size calculations.
7. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
9. Include annotated catalog data showing manufacturer's name, model, voltage, and catalog numbers for all equipment and components. Where multiple configurations of equipment or options are available, indicate specific configuration being submitted.
10. Provide complete battery calculations for both the alarm and supervisory power requirements. Ampere hour requirements for each system component shall be submitted with the calculations.
11. Provide complete riser diagrams indicating the wiring sequence of all devices and their connections to the control equipment. Provide a color code schedule for the wiring.
12. Provide floor plans showing the location of all devices and equipment. Show locations for all conduit and for all junction boxes used for T-taps. Indicate conduit fill percentages on the plans.
13. Provide data on each circuit to indicate that there is at least 25% spare capacity for notification appliances, 25% spare capacity for initiating devices. Provide circuit numbers for audible devices and load calculations for each circuit.
14. Provide a schedule of initiating device addresses and indicating device zones and subzones.
15. Include submittal data for all wire, terminal cabinets, and raceways.
16. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

17. Working drawings shall indicate 24 VDC power circuits necessary for system functionality. System vendor shall verify the functionality and capacity of circuits.
- D. Qualification Data: For qualified Design, Installer.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. Provide bound copies of an operation and maintenance manual. The manual shall include an index, copies of all approved shop drawings and submittal materials updated to "As Built", and a complete parts list of all components. The manual shall also include a list of recommended spare parts. The spare parts list shall include, for each item, the manufacturer's name, the serial number of the part, an ordering number, if appropriate, and a physical and electrical description of the part. In addition to items specified in Division 01 include the following:
1. Prepare and submit detailed CAD-based "As-Built" drawings. The drawings shall include complete plan view wiring diagrams showing connections between all devices and equipment, both factory and field wired, including, but not limited to, locations for all conduit and for all junction boxes used for T-taps. Indicate conduit fill percentages on the plans. All equipment in panels shall be shown in the as-built orientation. Include a riser diagram and drawings showing the as-built location and address or circuit number of all devices and equipment.
  2. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  3. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  4. Record copy of site-specific software.
  5. Matrix of Operations including all system inputs and outputs.
  6. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    - a. Frequency of testing of installed components
    - b. Frequency of inspection of installed components
    - c. Requirements and recommendations related to results of maintenance.
    - d. Manufacturer's user training manuals
  7. Manufacturer's required maintenance related to system warranty requirements.
  8. Abbreviated operating instructions for mounting at fire-alarm control unit.
  9. Include an electronic copy of the programming on CD for use by the Owner.
- G. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  3. Device address list.



1.7 QUALITY ASSURANCE

A. Designer Qualifications:

1. The Fire Alarm System Designer shall be capable of field surveying, design, and preparation of submittals required as part of this specification and certified as a Registered Professional Engineer in the Commonwealth of Pennsylvania who is experienced in fire protection systems or an individual who is certified as a Level III or IV Technician by NICET in Fire Alarm Systems.
2. The Fire Alarm System Designer shall have a minimum of 5 years of experience in the preparation of fire alarm system design including shop drawings, battery and voltage drop calculations, field surveying, and shall be regularly engaged in the design of the type and complexity if system required or specified in the contract documents.

B. Installer Qualifications:

1. Installation shall be accomplished by a Contractor with a minimum of five years' experience in the installation of fire alarm systems. Contractor shall show evidence of certification of at least one employee directly responsible for the work by the National Institute for Certification in Engineering Technologies (NICET) at Level II, III, or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology. Any proposed installer who cannot show evidence of such qualifications may be rejected. The services of a technician provided and certified by the control equipment manufacturer shall be provided to supervise installation adjustments and tests of the system. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

C. Distributor Qualifications:

1. The manufacturer's equipment distributor shall show evidence of certification by the manufacturer in the technical support of the system installed under this contract.
2. The distributor shall show evidence of certification of at least one employee by the National Institute for Certification in Engineering Technologies (NICET) at Level III or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology. At a minimum, training and experience shall consist of five years of progressive experience in the installation and design of fire alarm systems of similar size and complexity to that specified herein

D. Manufacturer Qualifications:

1. Testing Services or Laboratories: Construct all fire alarm and fire detection equipment in accordance with the latest edition of the following publications from Underwriters Laboratories (UL) and Factory Mutual Engineering Corporation (FM):
  - a. UL Fire Protection Equipment Directory.
  - b. UL Electrical Construction Materials Directory.
  - c. UL 464 - Audible Signal Appliances.
  - d. UL 864 - Control Units for Fire Protective Signaling Systems.
  - e. UL 1971 - Signaling Devices for the Hearing Impaired.
  - f. Factory Mutual Approval Guide.

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

## 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
  - 1. Notify Owner no fewer than 3 days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

## 1.9 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

## 1.10 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## 1.11 APPROVALS

- A. Any deviations from this specification shall be approved in writing by the Philadelphia Department of Parks and Recreation prior to design, bidding, or installation, whichever occurs first.

## PART 2 - PRODUCTS

### 2.1 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
  - 1. Comply with UL 268, operating at 24-V dc, nominal.

2. Comply with UL 2034, Standard for Single and Multiple Station Carbon Monoxide Alarms.
3. Detectors shall be two-wire type.
4. Base Mounting: 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. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Detectors shall have alarm verification capability and environmental compensation feature.
7. Smoke detectors shall be listed for use with the fire alarm control panel.

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. Detector sensitivity to be between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
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.)

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

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.)
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Duct smoke detectors shall be furnished, wired and programmed by the Division 28 contractor and installed by the Division 23 contractor. The Division 28 contractor shall coordinate sampling tube sizes and locations with Division 23.
5. Each sensor shall have multiple levels of detection sensitivity.

6. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
7. All duct smoke detectors located above finished ceilings or otherwise hidden from view shall be furnished with remote alarm indicator lamps, identification nameplates, and test stations.
8. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.2 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. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear polycarbonate lens mounted on a faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
  1. Rated Light Output: field selectable to 15/30/75/110 cd, Set as shown on drawings.
  2. Mounting: wall mounted unless otherwise indicated.
  3. All units shall have 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. 8. Mounting: Surface, unless otherwise directed.

## 2.3 ADDRESSABLE INTERFACE DEVICE

- A. Monitor Module Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts. Addressable monitor module shall provide an individual address for each device below using a supervised Class B circuit:
  1. Each non-addressable initiating device.
  2. Each addressable interface device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and *supervision by location*. Setting a device's address by physical means shall not be necessary.

## 2.4 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, horn/strobe, strobe, or other device requiring protection.
  1. Factory fabricated and furnished by manufacturer of device.

2. Finish: Paint of color to match the protected device.

**PART 3 – EXECUTION**

**3.01 EQUIPMENT INSTALLATION**

- A. Comply with NFPA 72, the plan drawings, specifications, manufacturer’s recommendations, and all applicable codes for installation of fire-alarm equipment. All wiring shall be installed in compliance with NFPA 70, National Electrical Code®.
- A. Smoke- or Heat-Detector Spacing:
  1. Comply with NFPA 72, “Smoke-Sensing Fire Detectors” Section in the Initiating Devices” Chapter, for smoke-detector spacing.
  2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, 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 Appendix A or Appendix B in NFPA 72.
  5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
  6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
  7. Detectors located on the ceiling shall be installed not less than 4 inches from a side wall to the near edge.
- B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- C. Remote Status and Alarm Indicators: Install near each smoke detector that is not readily visible from normal viewing position.

**3.02 FIELD WIRING**

- A. System circuits shall be configured as they are currently in each panel. Ensure capability at each panel to accept Class A/B, and Style Y/Z circuitry.
- B. New conduit shall be Electrical Metallic Tubing (EMT), minimum ¾-inch.
- C. All new wiring shall be as follows:

<b>CIRCUIT TYPE.</b>	<b>WIRE TYPE</b>
ADDRESSABLE DEVICE LOOP	16 AWG. /2 COND. TWISTED
ADDRESSABLE NETWORK CABLE	18 AWG. /2 COND. TWISTED, OR MULTI MODE

	FIBER
AUDIO RISERS	14 AWG. /2 COND. TWISTED, SHIELDED
SPEAKER CIRCUITS	16 AWG. /2 COND. TWISTED, SHIELDED
STROBE CIRCUITS	14 AWG. /2 COND. TWISTED
CONTROL WIRING	16 AWG. /2 COND. TWISTED

- D. All penetrations, through designated fire rated walls, ceilings, and floor slabs (which are 2-hour rated) shall be properly sealed with an approved rated fire stopping material. All fire stopping material shall be supplied and work performed as per project specifications. Contractor shall submit nine (9) copies of manufacturer's catalog data and installation details for fire stopping to the engineer for review and approval prior to installation.

### 3.3 IDENTIFICATION AND LABELING

A. Conductors

1. All circuit conductors shall be identified within each enclosure where a tap, splice or termination is made.
2. Each cable shall be identified as to service within each enclosure, pull box and junction box.
3. Conductor and cable identification shall be by single piece, plastic coated self-laminating printed markers, or by heat-shrink type sleeves. Markers shall be attached in a manner that will not permit accidental detachment.

B. Conduits and Boxes

1. Identify all fire alarm conduits, exposed, or concealed, with self-adhesive vinyl markers located at not more than 20 ft. intervals.
2. Markers shall read "FIRE ALARM" and shall be readable from the floor when in place.
3. All pull boxes and junction boxes shall have their covers stenciled "FA" in red paint. Letters shall be a minimum of 2 inches high with 1/2-inch stroke.

- C. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."

- D. Install framed instructions in a location visible from fire-alarm control unit.

### 3.4 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems.

1. Supervisory connections at valve supervisory switches.

3.5 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.

3.6 FIELD QUALITY CONTROL

- A. Removed items that can be salvaged or reused shall be turned over to the department of recreation maintenance department.
- B. Field tests shall be witnessed by authorities having jurisdiction and owner.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. 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.
- E. 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 NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "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 "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 of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- F. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- G. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

- I. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- J. 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.

### 3.7 TRAINING

- A. A total of 8 hours shall be provided by the manufacturer's representative. This shall be sufficient to accommodate any and all employees / shifts for a typical 8-hour training session.
- B. The Manufacturer's representative shall train the appropriate employees in use/care of the provided equipment. The training shall include the following items.
- C. General Operator training.
  - 1. Training shall be provided as specified for operations personnel and shall be included in the scope of the Contract.
  - 2. Operating personnel (Site Managers) must be familiar with the scope, operation, and capabilities of the fire alarm system. This training shall include system concepts, general design features, and detailed familiarization with the man/machine interface. This training must be reinforced with hands-on experience on all equipment. All operator courses shall be conducted at the site, and must be structured to minimize the length of the instructional periods.
- D. Manager/Supervisor Training.
  - 1. The Contractor shall provide a training program for supervisors and managers. This course should generally include the same subjects as the operator training, with additional depth to allow the managers/supervisors to train additional operators, and with additional emphasis on use of the system for management functions. This training should be designed to allow the supervisors to perform virtually all system and device operations, to produce and utilize various system management reports, to train operators and to perform or supervise routine service on console and terminal equipment and diagnosis of operating problems.

### 3.8 WARRANTY

- A. Provide Engineer with warranty certificates after AHJ acceptance of the associated system. Warranties shall start from date of Owner acceptance of project. All work shall be warranted for a period of at least one (1) year from final work acceptance by the owner, unless noted otherwise. Warranty coverage shall be all inclusive of materials, equipment, labor, faulty workmanship, hardware, software, etc. provided under work of this project.
- B. All defects in material, workmanship, design and/or Failure to meet guaranteed performance shall be corrected by the Contractor, at his own expense and in accordance with instructions of the Engineer.
- C. All damages caused by faulty workmanship, materials and/or design shall be repaired, to the satisfaction of the Engineer, within not more than three (3) days after the Contractor and/or manufacturer has been notified in writing of any Failures or warranty issues.



END OF SECTION 283111

## SECTION 310000 - EARTHWORK

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The work under this Section shall include all labor, material, equipment and all else necessary for cutting, proof rolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract. Work under this Section includes, but is not limited to, subgrade preparation, excavating, backfilling, and compaction for structures and foundations, pavements, sidewalks, landscaping areas, and utilities. The contractor shall pay for and coordinate the services of a geotechnical engineer and testing agency to perform quality control of the earthwork.
- B. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable material to ensure proper preparation of areas for the proposed improvements.
- C. Undertake any special construction procedures for the project as shown in the drawings and described by these specifications for preparation of pavement areas.

#### 1.2 RELATED DOCUMENTS

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

#### 1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM), latest edition
  - 1. C 33 Concrete Aggregates
  - 2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort
  - 3. D 1556 Density and Unit Weight of Soils in Place by the Sand-Cone Method
  - 4. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
  - 5. D 2167 Density and Unit Weight of Soil in Place by Rubber Balloon Method
  - 6. D 2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
  - 7. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  - 8. D 2937 Density of Soil in Place by the Drive-Cylinder Method
  - 9. D 3740 Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
  - 10. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
  - 11. D 4254 Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
  - 12. D 6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- B. American Association of State Highway and Transportation Officials (AASHTO), latest edition
  - 1. T 88 Particle Size Analysis of Soils
- C. Associated General Contractors of America
  - 1. Manual of Accident Prevention in Construction

#### 1.4 QUALITY ASSURANCE

- A. A geotechnical engineer familiar with the project requirements, selected and paid by the Owner, may be retained to perform construction inspection on site based on density testing, visual observation, and judgement. This inspection will not relieve the Contractor from their responsibility to complete the work in accordance with the drawings and specifications.
- B. Visual field confirmation and density testing of subgrade preparation and fill placement procedures shall be performed by the field geotechnical engineer as part of the construction testing requirements. The Contractor shall be informed as soon as possible of the test results.
- C. The geotechnical engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner, engineer, and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.
- D. All costs related to reinspection due to failures shall be paid for by the Contractor at no additional expense to Owner. The Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

#### 1.5 SUBMITTALS

- A. Testing Agency Qualifications: Provide a statement of qualifications of the geotechnical engineer and testing agency that will perform the quality control tasks required in Article 3.08.
  - 1. The geotechnical engineer shall be an experienced inspector working under the direction of the professional engineer licensed to practice in the Commonwealth of Pennsylvania who is experienced in providing engineering services related to earthwork.
  - 2. The testing agency shall be an independent laboratory having a minimum of three (3) years' experience in conducting the testing indicated herein.
  - 3. The testing laboratory shall meet the requirements of ASTM D 3740.
- B. Material Test Reports: Shall be provided from the testing agency indicating and interpreting test results for compliance on the following:
  - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
  - 2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill; provide for each material type and for every 5,000 cubic yards of each material.
  - 3. Material Gradation Tests.
  - 4. Electrical Resistivity and pH tests for sand used for water pipe bedding and backfill.
- C. Within 10 days after award of the contract, the Contractor shall submit to the Owner and engineer a schedule detailing the sequence, and time of completion of all phases of work under this section.
- D. At least two weeks in advance of imported fill use, the Contractor shall submit the following laboratory test data to the geotechnical engineer for each type of imported soil/gravel material to be used as compacted fill.
  - 1. Moisture and Density Relationship: ASTM D1557;
  - 2. Particle-Size Analysis: ASTM D2487; and,
  - 3. Plasticity Index: ASTM D 4318.
- E. Together with the above test data, the Contractor shall submit a 25-pound sample of each type of off-site fill material in an air tight container for the approval of the geotechnical engineer.

- F. Submit the name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the Owner and the engineer.

## 1.6 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
- B. Base Course: Layer placed between the subgrade and paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Approved soil materials imported from off-site for use as fill or backfill.
- E. Classification: No consideration will be given to the nature of earthen materials, and all excavation required for this Project will be designated as unclassified.
- F. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. For granular material, relative density is determined in accordance with ASTM D 4254.
- G. Excavation: Removal of material encountered down to subgrade elevations:
  - 1. Bulk Excavation: Excavation more than 10 feet in width.
  - 2. Overexcavation: Excavation of existing unsuitable material beyond limits shown on the Drawings for replacement with structural fill as directed by the Owner.
  - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond limits shown on the Drawings without direction by the Owner.
- H. Hard Material: Weathered rock, dense consolidated deposits, or buried construction debris (i.e., demolished brick walls, concrete, etc.) which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.
- I. Rock:
  - 1. General Excavation - Any material that cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 2 cubic yards or more; and,
  - 2. Trench Excavation - Any material that cannot be excavated with a backhoe having a break out force rated at not less than 44,000 lbs. (Caterpillar 235D or equivalent), and occupying an original volume of at least 2 cubic yards.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.
- K. Subbase: Material shown on the Drawings between the pavement base and subgrade.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

## 1.7 REGULATORY COMPLIANCE

- A. Codes and Standards: Perform earthwork complying with federal, state, and local regulations including the Occupational Safety and Health Act of 1970 as amended. Excavation and trenching

are regulated by OSHA. The Contractor shall perform all excavation and trenching work in accordance with 29 CFR 1926 Subpart P.

- B. Conform with Pennsylvania Act 287 and all amendments and other applicable regulations regarding notification of utility companies.
- C. Any pumped water shall be discharged from the Site in accordance with federal, state and local codes and regulations. Comply with all Philadelphia Water Department permit requirements.

#### 1.8 PROJECT CONDITIONS

- A. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 3 days prior to excavation.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify the Owner not less than 72 hours in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without the Owner's written permission.
- C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- D. Existing improvements, adjacent property, and other facilities and trees and plants that are not to be removed shall be protected from injury or damage, which may result from Contractor's operation.

### PART 2 - PRODUCTS

#### 2.1 ON-SITE FILL

- A. On-site excavated materials may be used as backfill provided they meet the following criteria:
  - 1. Suitable backfill materials include soil that complies with ASTM D 2487 soil classifications GW, GP, GM, SW, SP, and SM and having a maximum particle size of three (3) inches in any one dimension.
  - 2. Unsuitable backfill materials include any material having an excess of wood, timber, metal, rebar, organics, debris, or any other deleterious materials.
- B. It is not permitted for excavated materials unsuitable for fill in their as-is state to be processed on-site to comply with suitable backfill requirements. Concrete, brick, asphalt debris is not permitted to be broken or crushed on site to meet the above particle size requirement.
- C. The Contractor shall use the on-site soil judiciously to facilitate the construction schedule.
- D. Prior to placement, on-site material to be used as fill shall not contain:
  - 1. Debris other than crushed concrete and brick meeting the above requirements.
  - 2. Timber or railroad ties.
  - 3. Other deleterious materials such as steel rails, rebar, trash, etc.
  - 4. Hazardous material - Unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.

- E. Any bituminous concrete on the site shall be milled/removed prior to placing any fill and shall be reused only onsite immediately below the pavement stone base course.

## 2.2 OFF-SITE IMPORTED FILL

- A. If necessary, off-site fill shall be obtained and provided by the Contractor;
- B. Fill shall be clean, well graded granular soil which is non-expansive and non-collapsible and shall have between 5% and 15% by weight passing the #200 sieve. The portion passing the #200 shall be non-plastic with a plasticity index not greater than five. Fill with less fines (less than #200) may be required on project specific basis and as required by geotechnical engineer. Likewise, fill with more than 20% fines may be acceptable on a project specific basis or as identified in the geotechnical engineering study;
- C. Imported fill shall be free of all hazardous substances. Certification of compliance and, if requested, test results substantiating compliance shall be furnished to the Owner and geotechnical engineer by the Contractor not less than one week prior to its intended use;
- D. The Owner reserves the right to test off-site fill material for conformance with these specifications; and,
- E. The Contractor shall be responsible for all permits and regulatory requirements associated with off-site borrow sources.

## 2.3 STONE BACKFILL

- A. In accordance with PennDOT Publication 408, Section 703 for AASHTO No. 57 Stone.

## 2.4 GEOTEXTILES

- A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  1. Survivability: Class 2; AASHTO M 288.
  2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
  3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
  4. Tear Strength: 90 lbf; ASTM D 4533.
  5. Puncture Strength: 90 lbf; ASTM D 4833.
  6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
  7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

## 2.5 EQUIPMENT

- A. Compactor for mass earthwork shall be minimum 10-ton static-drum weight vibratory roller or 10-ton static-drum weight sheep foot compactor as appropriate for the type of soil material at the site or other compactor approved by the geotechnical engineer.
- B. Compactor for trenches and where access or maneuverability is limited, use a double drum walk-behind roller or vibratory plate compactor or "jumping jack" tampers.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Prior to all work of this section, the Contractor shall become thoroughly familiar with the site, site conditions, and all portions of the work falling under this section.
- B. The Contractor shall refer to the soil erosion and sediment control drawings for staging of earthwork operations and for erosion control measures to be implemented prior to commencement of earthwork.
- C. Locate and identify existing utilities that are to remain and protect them from damage.
- D. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements.
- E. Protect fences, structures, sidewalks, paving, curbs, etc. to remain from equipment and vehicular traffic.
- F. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the Owner.
- G. Remove from the site, material encountered in grading operations that, in opinion of Owner or geotechnical engineer, is unsuitable or undesirable for backfilling as per Article 2.01.
- H. Identify required lines, levels, contours and datum to bring site grades to the proposed subgrade conditions inferred from the drawings.
- I. Do not allow or cause any of the work performed or installed to be covered by work of this section prior to all inspections, tests and approvals.
- J. Perform excavation using capable, well maintained equipment and methods acceptable to the Owner and regulatory authorities having jurisdiction.
- K. When performing grading operations during periods of prolonged wet or dry weather, provide adequate measures for surface drainage and ground water control, and moisture control of soils (i.e., wetting or drying, scarify and discing) so as to place and compact the soil within the moisture content range two (2) percentage points of its optimum water content. Any disturbed areas should be proofrolled at the end of each day.
- L. Sloping, shoring, bracing, and fencing shall be installed in accordance with Federal OSHA requirements as well as the requirements of all regulatory authorities having jurisdiction.
- M. Allow no debris to accumulate on-site. Haul debris away from the site and dispose of at no cost to the Owner.

### 3.2 COMPACTION OF SUBGRADE SURFACES

- A. In areas to receive fill and at the final cut subgrade, proof roll and compact the exposed ground surface following clearing and grubbing and any required excavation with a minimum of four (4) passes of an approved compactor and obtain at least the following density requirement:

Location	Percent of Maximum Dry Density per ASTM D1557
Foundation Support, Pavements, Sidewalks and Wall Backfill	95%
Non-structural	90%

- B. The proof roll, truck and compactor equipment shall traverse the area at speed that permits the geotechnical engineer to comfortably walk alongside the equipment.
- C. Any soft areas exhibiting excessive weaving or unsatisfactory material identified during excavation, fill placement, compaction and proof testing shall be removed, replaced with suitable fill, and compacted as specified above.

3.3 UNDERCUT EXCAVATION

- A. When approved by the Owner and recommended by the geotechnical engineer, the Contractor may be required to remove natural soil materials in areas where fills are to be placed when determined to be undesirable in their location or condition. The Contractor shall be required to remove the undesirable material and backfill with approved material properly compacted.
- B. At locations where unstable or unsuitable soil is shown on the drawings or identified within the geotechnical engineering study, the removal and replacement of such soil shall be as directed on the drawings or as directed by the geotechnical engineer and the Owner.
- C. All material removed in the work of undercut excavation will be classified by the geotechnical engineer and Owner as either suitable for other use without excessive manipulation and utilized by the Contractor elsewhere in the work, or unsuitable for future use and manipulated as per Article 2.01.
- D. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.
- E. Backfill in undercut areas shall be placed as a continuous operation along with the undercutting operation. No backfill material shall be placed in water unless otherwise permitted by the geotechnical engineer.

3.4 EXCAVATION, FILL AND SUBGRADE PREPARATION

A. GENERAL

- 1. The Contractor shall cut or fill to the proposed subgrade elevations based on finished grades and the pavement thicknesses as shown on the drawings. Subgrade elevations shall be constructed to within 0 to minus ½ inch of the proposed grades specified.

B. EXCAVATION

- 1. Where existing grades are above proposed subgrade elevation, excavate materials to line and grade as shown in the drawings being careful not to over excavate beyond the elevations needed for building subgrades;
- 2. Excavate organic soils that do not provide adequate foundation support. Excavated on-site organic soils, which are unsuitable for fill may be used in landscaped areas and, if approved by the geotechnical engineer, as fill in parking area at least 5 feet below final elevation. Otherwise this material shall be disposed of as directed by Owner;



3. Excavated on-site soils, which meet the requirements of suitable fill may be used as fill; and,
4. Unsuitable material, such as wood and any other deleterious materials determined to be unsuitable by the geotechnical engineer for use as on-site fill, shall be disposed of as directed by Owner.

C. SUBGRADE PREPARATION FOR FILL

1. Existing grades below proposed grades and thus requiring fill shall be leveled prior to fill placement. The Contractor shall remove existing lawn and top soil in these areas prior to placement of any fill; and,
2. All existing grades to receive fill areas shall be proof rolled and compacted per Article 3.02.
3. Loose/Soft and unstable subgrade resulting from excessive moisture may be aerated and dried in-place. Following adequate drying time, the subgrade is to be densified in-place. Subgrade that cannot be aerated, dried, and densified in place shall be removed as described in Article 3.03.

D. FILL PLACEMENT

1. Rock or processed suitable debris pieces larger than six inches (6 inches) across shall not be part of fill;
2. Reduce soil clod size to a maximum of 2 inches before placement. Do not place frozen fill material;
3. No fill material shall be placed in areas of standing water, in areas of frozen or thawing ground, or in areas that have not been approved by the geotechnical engineer;
4. No fill materials shall be placed during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until all saturated surficial soils are returned to a satisfactory moisture content as determined by the geotechnical engineer;
5. Fill lift surfaces shall be made smooth and free from ruts or indentations at the end of any work day when precipitation is forecast to prevent saturation of surficial fill material. Fill surfaces shall be graded to drain and sealed with a smooth drum roller at the completion of each work day;
6. The fill shall be placed in uniform loose lifts not exceeding 8-inches thick and compacted with at least 4 coverages of a 10-ton static-drum weight roller;
7. Each lift shall be compacted to the minimum densities listed in Article 3.02 as appropriate for the project and as specified in the geotechnical engineering study;
8. The Contractor shall adjust the water content by aeration or adding water to achieve the required density. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule;
9. Wet, saturated material shall be air dried as necessary to achieve the field densities specified in this Section. Removal and replacement shall not occur without prior approval or Owner. Removal and replacement shall be used if necessary to facilitate the construction schedule;
10. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace with suitable compacted fill as approved by the Owner or Owners representative. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section; and,
11. Fill placed on slopes greater than 1 vertical to 3 horizontal shall have each lift benched onto the slope at least 3 feet.

3.5 PROOFROLLING

- A. The work covered by this subsection consists of furnishing and operating, proofrolling equipment at the direction of the Owner's representative and/or geotechnical engineer.

- B. Proofrolling shall be under the observation of the Owner's representative and/or the geotechnical engineer as described herein and under the following schedule:
  - 1. Immediately following the completion of excavation to proposed subgrades in cut areas, proofrolling shall be performed as specified; and,
  - 2. Immediately prior to and following stone base course placement, in pavement and building pad areas for final floor slab preparation, all subgrade and stone base areas shall be proofrolled. Any areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material or stone base course as directed by the geotechnical engineer and approved by the Owner.
- C. Proofrolling shall be done with 1 pass of a fully loaded tandem dump truck equal to or exceeding 50,000 lbs., or other construction equipment if approved by the geotechnical engineer.
- D. Construction methods shall be as follows:
  - 1. After the subgrade or stone base course has been completed within 0.50 foot of final grade, the subgrade or stone base course shall then be compacted and tested prior to commencement of proofrolling. The coverage areas and methods will be identified by the Owner's representative and/or geotechnical engineer. However, the roll shall be operated in a systematic manner so that the number of coverages over all areas to be proofrolled can be readily determined and recorded;
  - 2. The equipment shall be operated at a speed that the geotechnical engineer can comfortably and slowly walk alongside the equipment;
  - 3. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of an unsuitable material, and aeration of excessively wet material in areas that have been proofrolled, see Article 3.03. These areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor or weather, the corrective work and additional proofrolling shall be performed by the Contractor at no cost to the Owner; and,
  - 4. The Contractor shall protect all structural facilities on the project, such as but not limited to box culverts, pipe culverts, and utilities, from damage by the proofrolling equipment.

### 3.6 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks.
- C. Remove areas of finished subgrade judged to be unsatisfactory to the depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than the best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section.

### 3.7 FINISH ELEVATIONS AND LINES

- A. For setting and establishing finish elevations and lines, secure the services of a licensed land surveyor acceptable to the Owner and engineer.
- B. Provide elevation grade stakes and any other surveying necessary for the layout of the work. The Contractor shall conduct their work in such a manner that survey stakes will be protected as long as their need exists. Grade stakes, which are damaged or stolen, shall be replaced by the Contractor's surveyor at the Contractor's expense.

- C. Graded areas shall be uniform, hard and smooth, free from rock, debris, or irregular surface changes. Any deviation shall not result in changes in drainage areas or ponding. All ground surfaces shall vary uniformly between indicated elevations. Finish drainage ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize the potential for erosion.
- D. Correct all settlement and eroded areas for one year after date of project completion at no additional expense to Owner. Bring paved and landscaped areas to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation disturbed by construction using corrective measures.

### 3.8 FIELD QUALITY CONTROL

- A. The contractor shall coordinate all earthwork with the testing agency and geotechnical engineer to allow for inspection and testing. The geotechnical engineer shall provide full-time observation and testing of the compaction operations and provide documentation to the Owner.
- B. Allow geotechnical engineer to inspect and test each subgrade and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. The geotechnical engineer shall test compaction of soils in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937, and ASTM D 4254 as applicable. Tests shall be performed at the following locations and frequencies:
  - 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2200 sq. ft. or less of paved areas or building slab, but in no case fewer than three tests.
  - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
  - 3. Structural Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
- D. When the geotechnical engineer reports that subgrades, fills or backfills have not achieved degree of compaction specified, recompact and retest until specified compaction is obtained.

### 3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site to a regulated and permitted facility. Provide two copies of load manifest and permit from owner of the property where material is deposited.

END OF DOCUMENT 310000

## SECTION 311000 – SITE CLEARING

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The work under this Section shall include all labor, materials and equipment necessary for the Site Clearing as herein after specified and/or as otherwise required for the proper and timely completion of the Contract.
- B. This Section includes the following:
  - 1. Clearing, grubbing and disposal
  - 2. Demolition of existing features, including, but not limited to inlets, pipes, fencing, trees, stumps, curbing and underground tanks.

#### 1.2 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become the Contractor's property and shall be disposed of in accordance with all applicable regulations.

#### 1.3 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Notify utility locator service for area where Project is located prior to site clearing.
- D. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Owner and engineer to receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.
- E. All benchmarks and monuments shall be protected during construction. If disturbed or destroyed, they shall be replaced in original position by a licensed surveyor at the Contractor's expense.
- F. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT AND MATERIALS

- A. Contractor shall provide and use all necessary equipment and materials to perform work.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Provide erosion control measures in accordance with Section 312500, Soil Erosion and Sediment Control, prior to any construction activity.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated (if applicable). All trees and vegetation to remain shall be barricaded and protected during the construction process in accordance with plans and specifications.
- C. Limit of clearing is to be staked and verified by Owner or engineer prior to removal of any material.
- D. All trees and shrubs not designated to remain within the area to be graded, whether shown or not on the drawings, shall be cut and the stumps shall be completely dug out including all major root structures. Burning on site is not permitted.

### 3.2 UTILITIES

- A. The Contractor shall protect existing underground utilities from damage. The accuracy of the utilities shown on the plan as to line and grade is not guaranteed. Any damage caused by the Contractor to any utility shall be the responsibility of the contractor to correct.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted. If utilities are interrupted, arrange to provide temporary utility services.
  - 1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruption without Owner's written permission.

### 3.3 CLEARING AND GRUBBING

- A. Perform all clearing and grubbing work in accordance with PennDOT Publication 408 Specifications, Section 201.3, Clearing and Grubbing or as specified here.
- B. Clear the ground of existing organic matter within excavation areas to a depth of eight (8) inches below the existing ground. Remove remaining topsoil over 8 inches in depth, when directed. Stockpile removed topsoil as specified in Section 312500 – Soil Erosion & Sediment Control. Utilize stockpiled topsoil as needed throughout the project. Dispose of unused topsoil in accordance with section 3.03 below.
- C. Remove obstructions, objectionable material, rubbish, junk, trees, shrubs, grass, and other vegetation within the limit of disturbance to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots, unless otherwise specified. Existing three foot high site chain link fence to be cut flush with existing paving, grinded down if necessary and patched to match surrounding asphalt.
- D. 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 and compact each layer to a density equal to adjacent original ground as in accordance with Section 31 0000 - Earthwork.

3.4 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable or excess topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property in accordance with all applicable regulations.

END OF SECTION 311000

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## SECTION 312200 - GRADING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Grading shall include all work necessary to bring the designated locations of the project area to the grades shown on the Drawings.
- B. Grading shall include all Borrow Excavation, transporting, placement and compaction work required to provide the necessary material volumes to complete the designed grades for the project areas as shown in the Contract Drawings. Borrow Excavation work shall be comprised of two types of excavation:
  - 1. Common Borrow Excavation. This refers to soil material salvaged within the limit of disturbance of the project. This shall include soil that will be excavated and/or stockpiled in order to complete the work depicted in the Contract Drawings.
  - 2. Foreign Borrow Excavation. This refers to soil material required in addition to the material available from regrading operations, and will come from approved sources outside the limits of the project.
- C. Finished grades to be landscaped or seeded shall include a minimum topsoil layer of six inches (6") or as indicated on the Drawings. Finished grades to be otherwise surfaced shall allow sufficient elevation for the completed surface to produce the finished grades and elevations as shown on the Drawings.

#### 1.2 REFERENCES

- A. It is the Contractor's responsibility to be thoroughly familiar with the most recent revision or amendment to the following:
  - 1. Philadelphia Water Department, Standard Details and Standard Specifications for Sewers.
  - 2. Philadelphia Water Department, Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving (12-49).
  - 3. Philadelphia Streets Department, Standard Specifications for Paving and Repaving.
  - 4. Philadelphia Streets Department, Standard Construction Items.
  - 5. PennDOT Publication 408, Section 201 – Clearing and Grubbing
  - 6. PennDOT Publication 408, Section 205 – Borrow Excavation
  - 7. PennDOT Publication 408, Section 206 – Embankment
  - 8. PennDOT Publication 408, Section 802 – Topsoil Furnished and Placed

#### 1.3 QUALITY ASSURANCE

- A. The grading Contractor or subcontractor is subject to approval by the owner.
- B. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the owner.
- C. An as-built survey of completed grades and elevations shall be completed by the Contractor. This survey will be deliverable to the owner, or as otherwise directed, prior to any landscaping installation or final surfacing (seeding, paving, etc.) operations.



## PART 2 - PRODUCTS

### 2.1 FILL MATERIAL

- A. Fill material (both Common Borrow Excavation and Foreign Borrow Excavation) shall conform to Publication 408 Specifications, Section 205.
- B. All Foreign Borrow Excavation materials shall be free of seeds or live plant materials and all noxious or invasive plants and/or weeds. These materials shall be obtained from properly permitted and authorized sites. All Foreign Borrow Excavation materials shall also conform to the following:
  - 1. More than 35% passing No. 200 Sieve.
  - 2. Minimum dry mass density of 95 lb/ft<sup>3</sup> determined by PTM No. 106, Method B.
  - 3. Maximum liquid limit of 65, determined by AASHTO T89.
  - 4. Plasticity index of not less than liquid limit minus 30 (for soils with liquid limits of 41 to 65), determined by AASHTO T90.
- C. All fill materials shall be free from clay lumps, brush, litter, roots, stones 2 in. and larger, and other foreign materials.

### 2.2 TOPSOIL

- A. Topsoil shall be acceptable friable loam that is reasonably free of subsoils, clay lumps, litter, roots or other plant materials, stones (2 in. and larger), and other foreign materials.
- B. Topsoil may be produced onsite from existing appropriate soils by adding organic plant matter (mulch, shredded plants, etc) to constitute ten percent (10%), as determined according to AASHTO T194, and fully combined with the soil stockpile. Soils with clay content greater than thirty-five percent (35%) or sand content greater than seventy percent (70%) shall not be considered amendable to topsoil by this method.
- C. Topsoil shall have a minimum sixty percent (60%) passing through the No. 10 (2 mm) sieve as defined by AASHTO T88.

## PART 3 - EXECUTION

### 3.1 GRADING

- A. Install all required Soil Erosion and Sedimentation Control measures as described in these Specifications or indicated on the Drawings. Phasing of Erosion and Sedimentation Control Measures shall follow the sequence provided, or barring provision of a specified sequence shall be installed as appropriate to the Work and as directed by the owner/Authorized Representative. At a minimum, downstream sediment protection, limit-of-disturbance fencing, and vehicle/tire cleaning shall be instituted prior to commencing any clearing or grading activities.
- B. Perform all clearing and grubbing work in accordance with PennDOT Publication 408 Specifications, Section 201.3, Clearing and Grubbing – Construction and as specified in section 31 1000 – Site Clearing. Complete all clearing and grubbing (including stump removal) before starting other grading work.
- C. In areas of fill, complete grading to within three feet (3') of finished grade before excavating for and constructing sewers.

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- D. All grading work, except final grading where sewers are constructed in fill (see above), shall be completed within thirty (30) days of starting clearing and grubbing operations.
- E. Place embankment over pipes and embankment around manholes in accordance with the Standard Details and Standard Specifications for Sewers.

### 3.2 PLACEMENT AND COMPACTION OF FILL AND BACKFILL

- A. For general fill and backfilling, place materials in accordance with Section 206.3(b) (Embankment: Placement and Compaction) of PennDOT Publication 408.
- B. Where fill materials are to be placed within six inches (6") of the finished graded soil surface on areas that are to be revegetated, materials shall be compacted with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. Material shall not be placed in a wet or frozen condition.

### 3.3 PLACEMENT AND FINISH GRADING OF TOPSOIL

- A. Loosen or scarify all areas to be covered by topsoil to a minimum depth of three inches (3"). Remove and dispose of any stones or other objectionable material encountered.
- B. Place topsoil on the prepared areas, and (unless otherwise directed in the Drawings or by Owner/Authorized Representative) spread and compact to a uniform depth of six inches (6") to produce the elevations and grades as shown on the Drawings.
- C. Compact topsoil with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. A sheep foot roller may be used as appropriate.
- D. Material shall not be placed or compacted in a wet or frozen condition.

### 3.4 AS-BUILT SURVEY

- A. An as-built survey shall be completed by the Contractor and submitted to Owner/Authorized Representative for approval prior to commencing final surfacing operations, including paving or landscaping.
- B. The survey shall identify spot elevations sufficient to show the grading in accordance with the Drawings (or as modified by Owner/Authorized Representative). Spot elevations provided on the Drawings shall be duplicated as a minimum number of survey points for the as-built.
- C. Survey of as-built elevations and grades may be included in (or include) as-built dimensions and elevations for other infrastructure constructed under this Contract.
- D. Survey underground stormwater management basins in accordance with latest PWD as-built survey guidelines.

END OF SECTION 312200

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SECTION 31 23 50 - SAWCUTTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes the saw-cutting of existing concrete, bituminous pavement, and footway at the locations indicated on the plans.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. Saws shall be equipped with guides, blade guards, water-cooling system and cut-depth control. Sawcut shall be done at the nearest joint, if applicable. The joint shall be sawed continuously and shall be of sufficient depth to allow removal of the paving without disturbing the paving that is to remain.
- B. Contractor to mark out sawcut lines in field for approval by the Owner or Authorized Representative prior to proceeding with the pavement removal.

END OF SECTION 312350

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## SECTION 312500 - SOIL EROSION & SEDIMENT CONTROL

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The work of this Section includes all temporary erosion and sediment control and related and incidental operations, including:
1. Filter Bag Inlet protection;
  2. Stone and Concrete Block Inlet Protection;
  3. Compost filter sock;
  4. Temporary seeding and mulching;
  5. Rumble Pad Construction Entrance;
  6. Pumped Water Filter Bag;
  7. Temporary Stockpile Protection;
  8. Compost Sock Washout Station; and,
  9. Maintenance and repair of erosion and sediment control measures.

#### 1.2 SUBMITTALS

- A. Submit complete shop drawings and product information for all items to be furnished under this Section upon receipt of notice to proceed and prior to construction.

#### 1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary trades and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. Codes and Standards: Perform work in compliance with applicable requirements of governing authorities having jurisdiction. Construction operations shall be carried out in a manner such that soil erosion, air pollution, and water pollution is minimized. State, County, and Municipal laws concerning pollution abatement shall be followed.
- C. The recommendations and Standards set forth in the Erosion and Sediment Pollution Control Program Manual, published by the PA Department of Environmental Protection, shall be applicable where the work is not specifically detailed in this Specification, the accompanying Drawings, or the Erosion and Sediment Pollution Control Plan.
- D. The Contractor shall take action to remedy unforeseen erosion conditions and to prevent damage to adjacent properties as a result of increased runoff and/or sediment displacement. Stockpiles of wood chips, hay bales, crushed stone, and other mulches shall be held in readiness to deal immediately with emergency problems of erosion. All erosion control checks and structures shall be inspected after heavy rainfalls, and if damaged, repaired or replaced.
- E. No other construction activities may take place until appropriate Erosion and Sedimentation Control devices have been installed and approved by Owner/Authorized Representative. All changes to the Erosion and Sedimentation Control Plan must be approved by Owner/Authorized Representative prior to implementation.

#### 1.4 REFERENCES

- A. PennDOT, Publication 408 Specifications (most recent edition).
- B. Pennsylvania Department of Environmental Protection, Erosion and Sediment Pollution Control Program Manual (most recent version).
- C. Commonwealth of Pennsylvania, Department of Transportation (PennDOT)
  - 1. Bulletin No. 15: Approved Construction Materials.
- D. Philadelphia Water Department Tracking Number FY23-REHA-7188-01

#### PART 2 - PRODUCTS

##### 2.1 FILTER BAG INLET PROTECTION

- A. Filter bags shall be provided in accordance with PennDOT Publication 408, Section 860.
- B. Filter bags shall be manufactured to fit the opening of the catch basin or drop inlet. Filter bags will have the following features:
  - 1. Two dump straps attached at the bottom to facilitate the emptying of the bag;
  - 2. Lifting loops as an internal part of the system to be used to lift the filter bag from the basin;
  - 3. Restraint cord approximately halfway up the sack to keep the sides away from the basin walls, this cord is also a visual means of indicating when the sack should be emptied.
- C. Filter bag seams shall have a minimum certified average wide width strength per ASTM D-4884 of 300 psi.
- D. Inlet filter bags for installation in new or existing highway grate and open mouth grate inlets shall be listed in PennDOT Bulletin 15 or approved equal.
- E. City inlet (and curb opening portion of open-mouth grate inlet) protection shall be a synthetic filter manufactured from recycled synthetic fibers listed in PennDOT Bulletin 15 or approved equal.

##### 2.2 STONE AND CONCRETE BLOCK INLET PROTECTION

- A. In accordance with PennDOT Publication 408, Section 860.2(b).
- B. Inlet protection in roadway is not to include stone or berms.

##### 2.3 COMPOST FILTER SOCK

- A. Compost filter sock shall be provided in accordance with PennDOT Publication 408, Section 867.
- B. The compost socks shall be Filtrex Siltsox manufactured by Filtrex International LLC of Grafton, Ohio or approved equal as listed in PennDOT Bulletin 15

##### 2.4 PUMPED WATER FILTER BAG

- A. Pumped water filter bags shall be provided in accordance with PennDOT Publication 408, Section 855.

- B. Sediment filter bag shall be manufactured of non-woven geotextile material that filters soil particles while allowing discharge water to pass through the bag.
- C. The sediment filter bag seams shall be a double 401 lock chain stitch seam with minimum 200 lbs/inch sewn seam strength, tested in accordance with ASTM D-4884.
- D. The sediment filter bag shall have an adjustable spout large enough to accommodate a six-inch (6") diameter discharge hose.
- E. The pump discharge hose shall be inserted into the bags in the manner specified by the manufacturer and securely clamped.
- F. Filter bag shall be inspected daily. If any problem is detected pumping shall cease immediately and not resume until the problem is corrected.
- G. Filter bag shall be GTF-FB series from Frank Roberts and Sons, Inc., Dirtbag by ACF Environmental, or approved equal, and shall have a rated flow rate fifty percent (50%) greater than the attached pump.

## 2.5 TEMPORARY SEEDING AND MULCHING

- A. All stockpiles and inactive disturbed areas shall be seeded and mulched in accordance with the design plans if they are to be left exposed for more than twenty (20) days.

## 2.6 RUMBLE PAD CONSTRUCTION ENTRANCE

- A. Prefabricated rumble pad shall be installed according to manufacturer's recommendations. A sufficient number of pads shall be installed to provide a minimum of four (4) tire revolutions while on pad.
  - 1. More pads may be needed depending on site conditions.
- B. Accumulated materials shall be cleaned from the pads daily and as necessary and disposed of in accordance with all applicable regulations.

## 2.7 TEMPORARY STOCKPILE PROTECTION

- A. Compost Filter Sock provided in accordance with PennDOT Publication 408, Section 867.
- B. Seeding in accordance with PennDOT Publication 408, Section 804.2(b), Formula E.

## 2.8 COMPOST SOCK WASHOUT STATION

- A. Concrete washout water shall be directed to the compost sock washout station as indicated on the plans. The compost sock washout station shall be comprised of a compost filter sock in accordance with this specification.

## 2.9 TEMPORARY STABILIZATION MEASURES

- A. Rolled Erosion Control Products (RECPs) shall be in accordance with PennDOT Pub. 408 Section 806, and from an approved supplier named in Bulletin 15. Non-biodegradable materials shall not be acceptable (including pins or stakes). Installed RECPs shall also be seeded or mulched as appropriate.



- B. Temporary seeding or sodding shall be in accordance with the specified permanent seeding and/or sod requirements, or in the absence of such specified materials shall be in conformance with PennDOT Pub. 408 Section 804, Formula E seed mixture.
- C. Mulch shall be in accordance with the specified permanent mulch, or in the absence of such specified materials shall be in conformance with PennDOT Pub. 408 Section 805, Wood Fiber or Wood Chips. Recycled materials shall not be acceptable for use as mulch (wood pulp, cellulose, etc.).
- D. Straw or hay temporary stabilization shall only be permitted when use of seeding/sodding or mulch is impracticable (subject to approval by Owner/Authorized Representative). The use of blown straw shall only be accepted when used in conjunction with a tackifier as specified herein. Straw or hay shall be free of weed seeds or other contaminants.
- E. Tackifier shall be Earth Bond tackifier (Turf Guard Manufacturing Inc.) or approved equal. Tackifier shall be composed of organic compounds, and contain no toxins or hazardous materials.

### PART 3 - EXECUTION

#### 3.1 GENERAL REQUIREMENTS

- A. All temporary erosion and sediment control measures specified herein shall be in place before the beginning of any earthwork or excavation.
- B. All erosion and sediment control devices shall be installed according to the manufacturer's specifications, or in accordance with PennDOT Pub. 408 if no manufacturer recommendation exists.
- C. When temporary erosion and sediment control measures as described herein do not provide adequate control, replacement or relocation of measures shall be required as directed by the Owner/Authorized Representative.
- D. Erosion and sediment control measures shall be inspected weekly and after every precipitation event.
- E. Contractor shall maintain complete written logs of inspections and shall make them available to PWD Inspector/Owner/Engineer upon request.
- F. All maintenance work, including but not limited to cleaning, repair, replacement, regrading, and restabilization of temporary erosion and sediment control measures shall be performed immediately.
- G. Contractor shall ensure that erosion and sedimentation control measures remain in place and fully functional until site achieves final stabilization.
- H. Orange fencing shall be used to delineate the limits of earth disturbance in all off street applications, and as specified in Section 015639 for tree protection.

#### 3.2 PUMPED WATER FILTER BAG

- A. Sediment-laden water shall be pumped through a pumped water filter bag as specified herein.

- B. Filter bags shall be removed and replaced when they have reached their capacity to filter sediment effectively, or upon any breach of the filter bag.
- C. The Contractor shall not discharge to any sewer without the prior approval of PWD from the Industrial Waste Unit.

### 3.3 TEMPORARY INLET PROTECTION

- A. The downstream inlets from the site of any disturbance or construction on the project site shall be protected with approved inlet protection practices. Downstream inlets are considered to be the next immediate inlet downslope that will receive runoff from the site of any disturbance, as well as any and all inlets within the site itself.
- B. All new inlets shall be protected with approved inlet protection practices upon installation. Inlets draining exclusively to a stormwater feature shall remain fully closed to runoff until final site cleanup.
- C. Final site cleanup shall include removal of all temporary inlet protection, cleaning of all permanent inlet protection, and cleaning of all inlets (existing downstream inlets and newly installed) of accumulated construction debris and sediment.
- D. Highway grate and open mouth grate inlets shall be protected using inlet filter bags as specified herein.
- E. Open mouth grate inlets and open mouth inlets (city inlets) shall be protected with a compost sock or synthetic filter as specified herein.
- F. Inlet protection shall be installed, inspected, cleaned and replaced according to manufacturer's specifications.
  - 1. Inlet filter bags and open mouth inlet protection shall be removed and replaced when filled with silt or when extended periods of ponding occur following a precipitation event. New inlet filter bags or approved inlet protection devices shall be installed and secured immediately after removal of silted protection devices.

### 3.4 STORAGE STOCKPLIES

- A. Stockpiles of all loose materials (aggregate, fill, soils, etc) shall be protected from dust and rain by use of a cover. The cover shall be free of defects, and secured adequately to maintain protection of the materials. Owner/Authorized Representative reserves the right to refuse use of any material that has been compromised by inadequate protection onsite.
- B. Stockpiles shall not be placed upslope from any infiltration structure. Any drainage structure (such as but not exclusively inlets) downslope of a stockpile shall be adequately protected from runoff.
- C. Stockpile heights are not to exceed 20 feet high. Stockpile slopes shall be 2:1 or flatter.

### 3.5 TEMPORARY STABILIZATION

- A. Any disturbed surfaces to remain unfinished and unprotected for more than four (4) days shall be temporarily stabilized. Method to be used shall be approved by the Project Manager and shall be appropriate to the expected length of time employed (for example, use of hay alone without seeding would not be appropriate for a several month application, but could be appropriate for a week-long site delay).

3.6 REMOVAL AND FINAL CLEANUP

- A. Once the site has been fully stabilized and approval is given by Owner/Authorized Representative, temporary erosion and sedimentation control measures and all accumulated silt and sediment shall be removed. All permanent inlet protection measures shall be cleaned, inspected, and verified to be in working order.
- B. Any remaining dirt or debris within the public right of way shall be removed by the Contractor, using necessary means as sufficient to remove the dirt and debris from the public right of way. This may include, but is not limited to, street sweeping, sidewalk vacuuming, inlet cleaning, power washing, or hand removal.
- C. Silt and waste materials shall be disposed of in a proper manner. No extra construction materials are to remain onsite upon completion of the Work. The Work of this Contract shall not be considered complete until all extraneous construction-related items have been removed (temporary traffic control devices, signage, etc).

END OF SECTION 312500

## SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The work under this Section shall include all labor, on-site materials, and equipment necessary for the excavation of trench and grading as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract.

#### 1.2 RULES AND REGULATIONS

- A. American Society for Testing and Materials (ASTM):

1. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
2. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM C535 Standard Test Method for Resistance to Degradation of Large-Size Aggregate by Abrasion and Impact in the Los Angeles Machine
4. ASTM D653 Standard Terminology Relating to Soil, Rock, and Contained Fluids
5. ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75- $\mu$ m (No. 200) Sieve in Soils by Washing
6. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))
7. ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes
9. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
10. ASTM D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
11. ASTM D4254 Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
12. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13. AASHTO T180 Standard Method of Test for Moisture-Density Relations of Soils Using 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop

#### 1.3 SUBMITTALS

- A. Samples

1. Furnish and deliver samples of fill and backfill materials as selected by the Engineer.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. If any hazardous waste materials are discovered on the site, the Contractor shall cease operations in that area until authorized to resume. The Contractor shall notify the Engineer of such material and cooperate with any outside agency or specialist that may be called in to determine the extent of the hazard and methods of its disposition.

- B. Tolerances:

1. Construct finished sub-grades to plus 0 inches minus ½ inch of the elevation indicated.

2. Construct finished grade of slopes not steeper than 3H:1V to plus or minus 1/2 inch and on slopes steeper than 3H:1V to plus or minus 2 inches. Slopes shall not encroach upon roadbeds.
3. Maintain the moisture content of fill material as it is being placed within plus or minus 3 percent of the optimum, moisture content of the material as determined by the laboratory test herein specified.
4. Protect all existing and new construction including utilities, finishes and equipment from water, damage, weakening or other disturbance.

## 1.5 DEFINITIONS

- A. Earthwork Terminology used in this Section and not defined herein shall be interpreted in accordance with the definitions given in ASTM D653.
1. Sub-grade: Sub-grade is the lowest elevation of excavation and the highest elevation if embankment required to accommodate the indicated construction.
  2. Backfill: Soil or soil-rock material used to refill excavations and to refill excavated spaces around building walls.
  3. Imported Material: Soil or granular material which is hauled in from off-site areas.
  4. Unsuitable Material: Excavated material or material below the natural ground surface in embankment areas or below sub-grade elevation in excavated areas, which is unsuitable for its planned use.
  5. Relative Compaction: The ratio, expressed as a percentage, of the in-place place dry density of fill material as compacted in the field to the maximum dry density of the same material as determined by laboratory test ASTM D1557, Method D.
  6. Optimum Moisture Content: The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
  7. Relative Density: Refer to ASTM D4253 and ASTM D4254.
  8. Excavation: Excavation is the removing of all materials encountered within the Contract Limits, regardless of the nature of the material encountered and the method by which it is removed, for grading, sub-grading for roadways or paved areas and other structures not specified elsewhere in these specifications. All excavation is unclassified and no additional compensation will be made for rock.

## 1.6 PROJECT CONDITIONS

- A. Protection
1. Provide the necessary barricades, signs, lights, etc. to prevent accidents, to avoid all hazards and to protect the public, the work and property at all times, including Saturdays, Sundays, and holidays.
  2. Be responsible for any and all damages which may arise or occur to any party whatsoever by reason of neglect in providing proper lights, guards, barriers or any other safeguards to prevent damage to property, life and limb.
  3. Prior to any excavation the Contractor, with the cooperation of the Owner of the respective existing utility or its agents shall locate and paint the location of all water services, gas services, gas mains, water mains, sanitary sewers, telephone raceways or conduits and drains, within five (5) feet of the proposed excavations.
  4. In case water, gas pipes, conduits, or other utilities are broken in the prosecution of the work, the Contractor shall stop work and give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks. Failure to give prompt notice to the authorities shall deem the Contractor responsible for any damages legal or otherwise caused by the interruption or loss of utility service.
- B. Parking and Storage

1. Parking of vehicles and storage of materials shall be confined to designated areas approved by the Owner.

C. Dust Control

1. During the progress or work, the Contractor shall conduct his operation and maintain the area of his activities so as to minimize the creation and dispersion of dust.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Unfavorable Weather Conditions

1. Excavating, filling, backfilling, and grading work shall not be performed during weather conditions which might damage the condition of existing ground, in-progress work, or completed work. When the work is interrupted by rain, excavating, filling, backfilling and grading work shall not resume until the site is suitable for the work.
2. Sub-grade shall be free from mud, snow, ice, and deleterious material when work is resumed.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

- A. Material suitable for use as fill and backfill shall be an inert, non-expansive soil, free from organic matter and of such quality that it will compact thoroughly without the presence of voids. Excavated on-site soil will be considered suitable for fill and backfill.
- B. Suitable excavated material shall be conditioned for reuse and properly stockpiled for later filling and backfilling operations. Conditioning shall consist of spreading material in layers not to exceed 8 inches and raking free of debris and rubble. Rocks exceeding four inches in largest dimension and deleterious material shall be moved from the site and disposed of.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES

- A. Verify on site the location and depth (elevation) of all existing utilities and services before performing any excavation work. Excavation within 3 feet of a utility line shall be performed by hand.

3.2 EXCAVATION

A. General

1. Excavation consists of the removal and on-site placement or disposal of whatever material is encountered when establishing required sub-grade elevations.
2. Excavation shall be made to the grades as shown on the Contract Drawings.
3. Where excavation grades are not shown on the Contract drawings, excavation shall be made as required to accommodate the installation of all facilities.

B. Cold Weather Protection

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit.

- C. Stability of Excavations
  - 1. Sloped sides of excavation shall comply with state and local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
  - 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- D. Shoring and Bracing
  - 1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
  - 2. Establish requirements for trench shoring and bracing to comply with local Codes and authorities having jurisdiction.
  - 3. Maintain shoring and bracing excavations regardless of the time period excavations will be open. Carry down shoring and bracing as excavation progresses.
- E. Material Storage
  - 1. Stockpile suitable excavated materials where directed, as required for fill.
  - 2. Locate and retain soil materials away from edge of excavation.

### 3.3 BACKFILL

- A. Backfill excavation as promptly as work permits, but not until waterproofing membrane is applied and is ready to be backfilled, if applicable.
- B. Placement and Compaction
  - 1. Place backfill materials in layers not more than 4" in loose depth for materials by hand-operated tampers.
  - 2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each life.

### 3.4 GRADING

- A. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish below the required sub-grade elevations.

### 3.5 CLEAN-UP

- A. Upon completion of the work of this section, place in stockpile areas all excess excavated material, rubbish, trash and debris resulting from operations. Leave the site in a neat and orderly condition.

END OF SECTION 315000

## SECTION 321116 – SUBBASE COURSE

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. This item consists of the preparation of the subgrade and the construction of a layer of aggregate of the depth indicated, to the lines and grades shown on the drawings, or as directed by the engineer.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### PART 2 - PRODUCTS

#### 2.1 AGGREGATE

- A. Aggregate to be provided in accordance with contract drawings and PennDOT Publication 408, Section 703

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Subbase material shall not be placed on soft, muddy or frozen areas, nor until all irregularities in the prepared areas, including soft areas in the foundation, have been satisfactorily corrected. The subgrade shall be compacted to not less than one hundred percent (100%) of the determined dry weight density.
- B. Unstable subbase conditions, including soft foundation areas which develop ahead of the base and paving operations shall be satisfactorily corrected by scarifying, reshaping, and compacting, or by replacement as required.

#### 3.2 PLACEMENT

- A. The subbase material shall be maintained in a moist condition during hauling, placing, and compacting, and shall be deposited on the prepared area by means of an approved mechanical spreaders in a matter that will not cause segregation. Graders, bulldozers and similar equipment shall not be considered as approved mechanical spreaders. Subbase shall be constructed in layers of uniform depth not to exceed eight inches (8") in compacted depth. However, when granulated slag is used as a subbase material, the maximum compacted depth of each layer shall be four inches (4"). A maximum compacted layer of six inches (6") may be placed when approved equipment and compaction pattern establishes that the density required is obtained for the full depth of each layer.
- B. When constructed in part width, the extension of the subbase construction shall not proceed to its full width until the existing edge of the subbase is trimmed and all foreign and deleterious material is removed from the remaining prepared area.



### 3.3 COMPACTION

- A. The uniformly spread material shall be compacted by means of approved equipment to not less than one hundred percent (100%) of the maximum dry weight density (PENNSYLVANIA TEST METHODS (PTM) No. 106, Method B) as determined by PTM No. 112, or PTM No. 402. When the material is too coarse to satisfactorily use these methods, compaction will be determined by the Engineer based on non-movement of the material under the specified compaction equipment. Compaction shall progress gradually from the sides to the center with each succeeding pass uniformly overlapping the previous pass, and shall continue until the entire area is satisfactorily shaped and compacted to the required lines and grades. One (1) density determination shall be made for each three thousand (3,000) square yards or less, on each layer of completed subbase.

### 3.4 DEPTH TEST

- A. The depth of the finished subbase will be determined by cutting or digging holes to the full depth of the completed subbase. One depth measurement shall be made for each three thousand (3,000) square yards, or less, of the completed subbase. Any section in which the sub-base is one half inch (1/2") or more deficient in specified depth shall be scarified to a depth of at least three inches (3"), blended with the necessary additional material, and then recompactd to the specified density and depth or otherwise satisfactorily corrected.
- B. All test holes shall be cut or dug, backfilled with similar material, and satisfactorily compacted by and at the expense of the Contractor. This operation shall be under the direct supervision of the inspector who will check the depth for record purposes.

### 3.5 MAINTENANCE OF TRAFFIC

- A. No traffic shall be allowed on the completed subbase other than necessary local traffic and that developing from the operation of essential construction equipment, unless otherwise directed by the Engineer. Any defects which may develop in the construction of the subbase or any damage caused by the operation of local or job traffic is the responsibility of the Contractor and shall be immediately repaired or replaced at the expense of the Contractor.
- B. The completed subbase shall be uniformly moistened immediately prior to the construction of the base course and/or pavement, except when a hot-mix bituminous base course is to be placed.
- C. Completed subbase which has been subjected to hauling or exposed to the elements for periods in excess of one-hundred-twenty (120) calendar days will require re-testing of the material and re-approval by the Engineer before construction of the base course or pavement may proceed. Subbase so used or exposed, not meeting the requirements herein specified shall be reconstructed or replaced as directed by the Engineer at the expense of the Contractor.

END OF SECTION 321116

## SECTION 321223 - ASPHALT PAVEMENT COLORCOATING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Asphalt pavement colorcoating for the sport courts. The Contractor shall furnish all labor, materials and equipment required for the complete leveling/patching and surfacing of all areas indicated on the plans to the satisfaction of the Owner or Owner's Representative.

A. Related Sections:

1. Section 116833 "Athletic Equipment"
2. Division 32 for Asphalt Pavement

#### 1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's data on colorcoating.
- B. Color Samples: Full range of standard colors for selection by Owner and Landscape Architect.
- C. Instructions: Provide manufacturer's application instructions.

#### 1.3 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum two years' experience.

#### 1.4 TEST MATERIALS

A. The Owner reserves the right to sample materials both as delivered to the job site in unopened drums and after dilution and mixing prior to application. Such testing shall be by an independent laboratory of the Owner's choice to assure that the materials meet the standards set by this specification.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply colorcoating when ambient air temperature is less than 50 degrees F, nor during fog, rain, or other unsuitable conditions. Do not apply when surface temperature is below 40 degrees F or in excess of 140 degrees F.
- B. Surfacing system shall be asbestos free.

#### 1.6 SUBSTITUTIONS

A. Under provisions of Division One Specification Sections.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Basis of Design: California Products Corporation, Plexipave, 150 Dascomb Rd., Andover, MA 01810, (978) 623-9980, <https://www.californiasportssurfaces.com/>, or approved equal.

## 2.2 MATERIALS

- A. Acrylic Patching System: Shall be court patch binder conforming to manufacturer's specifications.
- B. Crack Filler: Shall be a fortified acrylic type filler for use in fine cracks (less than 3/16" wide) conforming to manufacturer's specifications.
- C. Acrylic Resurfacer: Shall be a 100% acrylic emulsion binder conforming to manufacturer's specifications.
- D. Finish Coating: Shall be a reinforced acrylic finish coating conforming to manufacturer's specifications, color TBD.
- E. Line Paint: acrylic latex, color White for basketball and tennis courts, TBD for mini-pitch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that existing paving surface is ready to receive work.
- B. Verify that mini-sport court fencing and goals are installed and ready to receive work.
- C. Beginning of colorcoating application means acceptance of existing conditions.

### 3.2 PREPARATION

- A. Surface Preparation
  - 1. The asphalt paving surface shall be thoroughly cleaned, removing all loose dirt, oil, grease, leaves, and drippings and scrub with a detergent and water. Remove all traces of detergent.
- B. Holes and Cracks
  - 1. Where asphalt paving surface cracks occur, they shall be milled to remove all asphalt humps, cleared of all debris, dirt, and vegetation, sprayed with an approved soil sterilant, and filled with court patch binder as recommended by colorcoating manufacturer. Hairline fissures will not be considered as surface cracks.
  - 2. Where open joints or cracks occur (more than 3/8 inch wide and less than 1 inch wide), they shall be milled to remove all debris, dirt, and vegetation. Spray with an approved soil sterilant, backfill with crushed stone, and seal with bituminous paving.
  - 3. Where open joints or cracks occur (1 inch wide or greater), they shall be milled to remove all debris, dirt, and vegetation. Spray with an approved soil sterilant, backfill with No. 8 coarse aggregate, and seal with 1 1/2" of bituminous paving.
- C. Depressions
  - 1. Depressions holding enough water to cover a five cent piece shall be filled with court patch binder patching mix, as recommended by the surface colorcoating manufacturer.
- D. Curing

1. New asphalt concrete surface should be allowed to cure a minimum of 10 to 14 days prior to application of colorcoating.

E. Sports Courts

1. Install mini-pitch rebound walls and two goals, according to specification section 116833 “Athletic Equipment”, and manufacturer’s instructions.

3.3 APPLICATION

A. General

1. All areas to be colorcoated shall be clean, free from sand, clay, grease, dust, salt, or other foreign matters. The Contractor shall obtain the Owner’s approval, prior to applying any surface treatment. The storage of materials, mixing, and surface preparation shall be in accordance with the manufacturer’s instructions.
2. The Contractor shall arrange for a representative of the surfacing material manufacturer to be present at the start of the work, to check installation conditions, and to instruct the applicators as to proper methods and procedures, and also as may be necessary during the course of the work, to insure a satisfactorily completed installation.
3. The application shall be done by thoroughly experienced and skillful workmen, in strict accordance with the manufacturer’s instructions.

B. Filler Coat

1. Filler coat (acrylic resurfacer) shall be applied to the clean underlying surface in one application to obtain a total quantity of not less than 15-20 yards per gallon based on the material prior to any dilution. Apply filler coat as recommended by the surface colorcoating manufacturer.
2. Allow filler coat to dry thoroughly. Scrape off all ridges and rough spots prior to any subsequent application of acrylic resurfacer or color surface system.

C. Finish Coating

1. The Contractor shall apply two (2) coats of Fortified Plexipave reinforced acrylic finish coating.
2. Each finish coat shall be applied at a rate of 0.4 - 0.5 gallons per square yard. Allow each coat to dry thoroughly prior to any subsequent applications of color surface system.
3. Apply the second coat at a 90 degree angel to the previous coat.
4. The finished surface shall have a uniform appearance and be free of ridges and tool marks.

3.4 PROTECTION

- A. Protect finished application under provisions of Section 01500.
- B. Do not permit traffic over pavement for 24 hours.

END OF SECTION 321223

## SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The extent of work specified herein includes sealants for site expansion joints in concrete paving and curbs.
- B. General Performance: Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application. Provide a quality bond. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

#### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work specified in this section.

#### 1.3 SUBMITTALS

- A. Submittals shall include actual sealant sample with color as selected by Owner's Representative.

#### 1.4 JOB CONDITIONS

- A. Weather Conditions: Do not proceed with installation of liquid sealants under unfavorable weather conditions. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer for installation.
- B. Where sealant is specified for joints, bituminous expansion joint filler is NOT to be used below sealant. Use closed cell polyethylene for expansion joint filler below sealant which requires no bond breaker.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. General Sealer Requirements: Color as selected by Owner's Representative to match pavement. Select materials for compatibility with joint surfaces and other indicated exposures, and except as otherwise indicated, select modulus of elasticity and hardness or grade recommended by manufacturer for each application indicated. Where exposed to foot traffic, select non-tracking materials of sufficient strength and hardness to withstand stiletto heel traffic without damage or deterioration of sealer system.
- B. Elastomeric Sealants
  - 1. Approved Products (or approved equal):
    - a. "Sonolastic NP II" by Sonneborn
    - b. "Sonolastic Paving Joint Sealant" by Sonneborn
- C. Miscellaneous Materials

1. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.
2. Bond Breaker Tape: Do not use. Expansion joint and sealant materials shall be compatible so as not to require bond-breaker tape. Contact manufacturer for more information.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Apply sealant where shown on drawing details.
- B. Apply sealant where structure abuts another similar or different structure.

#### 3.2 INSPECTION

- A. Contractor shall examine substrates, joint surfaces and conditions under which joint sealer work is to be performed. Do not proceed with joint sealer work until unsatisfactory conditions have been corrected.

#### 3.3 JOINT PREPARATION

- A. Clean joint surfaces immediately before installation of gaskets, sealants or caulking compounds. Remove dirt, insecure coatings, moisture and other substrates which could interfere with seal of gasket or bond of sealant or caulking compound. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.
- B. Prime or seal joint surfaces where indicated, and where recommended by sealant manufacturer. Confine primer/sealer to areas of sealant bond; do not allow spillage or migration onto adjoining surfaces.

#### 3.4 INSTALLATION

- A. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

#### 3.5 CURE AND PROTECTION

- A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Cure and protect sealants in a manner that will minimize increases in modulus of elasticity and other accelerated aging effects. Replace or restore sealants that are damaged or deteriorated during construction period.

END OF SECTION 321373

## SECTION 321500 – SITE 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. Brick veneer for site walls.
- B. Related Requirements
  - 1. Section 034550 – Site Precast Architectural Concrete.
  - 2. Section 321300 – Site Concrete.

#### 1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials:
  - 1. ASTM A666 - Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. American Society for Testing and Materials:
  - 1. Design anchor attachment to masonry units with a factor of safety of 5:1.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated including, but not limited to:
  - 1. Cementitious materials. Include brand, type, and name of manufacturer.
  - 2. Setting bed mortar mixes. Include description of type and proportions of ingredients.
  - 3. Joint sealants and backer rods.
  - 4. Anchors, clips, dowels, pins and other metal accessories.
  - 5. Shims and setting buttons; plastic or nylon.
- B. Samples for Initial Selection
  - 1. For colored sealant, jointing materials and other items involving color selection. Include sample of manufacturers full range of standard colors.
- C. Samples for Initial Selection
  - 1. Brick: Three (3) units for each type of product specified.
- D. Samples for Verification

1. Setting Bed Materials
2. Jointing Materials

E. Shop Drawings for Walls and Steps:

1. Show sizes, dimensions, profiles, finishes, jointing, anchoring system and other necessary information required to convey full scope of work.
2. Include adjacent Work, including but not limited to, paving, adjoining work, and soil or fill conditions at specified finished grades.
3. Utilize same designations or naming as indicated on the Drawings for site features such as walls and seat walls.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs experienced masons and fitters.
- B. Source Limitations: Obtain each variety of masonry unit, regardless of finish, from one source with resources to provide materials of consistent quality in appearance and physical properties.
- C. 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.
- D. Refer to Section 042000 Unit Masonry and Section 047200 Calcium Silicate Manufactured Masonry for additional requirements, including but not limited to, preconstruction testing, quality assurance, project conditions, and execution requirements.
- E. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Locations of mockups to be submitted for approval by Landscape Architect. Preferred mockup location for veneered wall and stairs to be adjoining to evaluate intersections and connections of work and associated concrete backup.
  2. Build mockups for each type of site masonry including, but not limited to,
    - a. Brick veneer wall including stone coping: Full wall height by three (3) coping widths per Drawings. Provide jointing mockups as required. Include full vertical joint and full horizontal joint including grout and sealant with backer rod in mockup. More than one and grout sealant color may be requested.
  3. Consult Landscape Architect prior to constructing mockups.
  4. Protect accepted mockups from the elements with weather-resistant membrane.
  5. Approval of mockups is for color, texture, and blending of masonry units; relationship of sealant or grout color to masonry unit color; tooling of joints; and aesthetic qualities of workmanship.
    - a. Jointing grout and sealant shall be fully cured prior to review for accurate color representation.
    - b. Approval of mockups is also for other material and construction qualities Landscape Architect specifically approves in writing.
    - c. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.



6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 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 designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.8 PROJECT CONDITIONS

- A. Protection of Masonry: Cover partially completed masonry when construction is not in progress to protect from inclement weather.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the exposed surfaces of masonry.
  1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.
  2. Protect all exposed surfaces from mortar droppings, including adjacent constructions such as exposed aggregate concrete pavement or any other adjacent surface.
- 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 masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning. Protect all exposed surfaces from mortar droppings, including adjacent constructions such as exposed aggregate concrete pavement or any other adjacent surface.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 60

#### 1.9 COORDINATION

- A. Advise installers of other work about specific requirements for placement of reinforcement, veneer anchors, and similar items to be built into masonry.

- B. Verify field measurements prior to fabrication. Notify Landscape Architect of any discrepancies prior to fabrication.

#### 1.10 WARRANTY

- A. Unless stated otherwise in these Specifications, warranty shall state that all work is in accord with drawings and Specifications, as amended by any changes thereto authorized by the Landscape Architect, free from defects in materials and workmanship for a period of five (5) years from date of acceptance of the work by the Owner or failure of system to meet performance requirements. Contractor shall agree to repair or replace defective materials and workmanship during the guarantee period at no additional cost to the Owner.
  - 1. Defective materials and workmanship are hereby defined to include evidence of abnormal deterioration, aging, structural failure of components resulting from exposure to normal load and forces, failure of operating parts to function normally, sealant failures, deterioration or discoloration of finishes in excess of normal aging, and failure to fulfill other specified performance.

### PART 2 - PRODUCTS

#### 2.1 BRICK VENEER

- A. Defective Material: Referenced standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Products: Refer to Section 042000 Unit Masonry for Primary Face Brick product information.

#### 2.2 CAST STONE UNITS

- A. Defective Material: Referenced standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Products: Refer to Section 034550 Site Precast Architectural Concrete for Cast Stone product information.

#### 2.3 MORTAR AND GROUT MATERIALS

- A. Refer to Section 042000 Unit Masonry for mortar and grout material information.
- B. Application: Use colored aggregate mortar for exposed grout joints with the following units:
  - 1. Brick wall veneer.
  - 2. capstones.

#### 2.4 MORTAR MIXES

- A. General: Refer to Section 042000 Unit Masonry for mortar and grout material information.
- 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 C 270, Proportion Specification. Provide Type N unless another type is indicated.
- D. Water: Potable, clean and free from deleterious acids, alkalies, and organic matter.
- E. Mixing: Combine and thoroughly mix pre-blended dry materials to water in a mechanical batch mixer; comply with ASTM C270 proportion specification and manufacturer's instructions for mixing time and water content, unless otherwise indicated.

## 2.5 ANCHORS AND FASTENERS

- A. Anchor Material: Stainless steel, ASTM A 666, Type 304. Sizes and configurations: As required for vertical and horizontal support of masonry units and applicable loads.
- B. Dowels and Pins Material: Stainless steel, ASTM A 276, Type 304

## 2.6 TIES AND ANCHORS

- A. General: Ties and anchors shall 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. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
  - 2. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- C. Corrugated Wall Ties: Metal strips not less than 7/8-inch wide by 18 gauge by 7-inches long.

## 2.7 MISCELLANEOUS MASONRY ACCESSORIES

- D. Backer Rod for Sealant Joints: Flexible, closed cell, non-gassing, polyethylene, rope-like joint backing material of appropriate diameter for specified joint size as indicated on the Drawings to resist pressure during sealant tooling. Backer rod shall not stain or adhere to sealant materials and shall be fully compatible with sealant compounds.
- E. Sealant for Joints: In compliance with manufacturer's instructions, provide Sonneborn Sonolastic NP 2, or approved comparable product. Landscape Architect shall select color from the full range of standard colors.
- F. Weep/Vent Products: Use the following unless otherwise indicated:
  - 1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by length required to extend from exterior face of masonry unit to cavity behind.
- G. Setting Shims: Plastic or vulcanized neoprene.
- H. Setting Buttons: Resilient plastic buttons.

## 2.8 MISCELLANEOUS MATERIALS

- A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2, AASHTO M 288.
  2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
  3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- B. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, 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: Class 2, AASHTO M 288.
  2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
  3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
  4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- C. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

## 2.9 STONE FABRICATION

- A. Fabricate stone to comply with sizes, shapes, and tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
- B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated.
- C. Cut and drill slots, sinkages and holes in stone for anchors and supports.
- D. Carefully inspect stone at supplier, quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
  1. Clean sawed backs of stone to remove rust stains and iron particles.
- E. Thickness of Stone: Provide thickness indicated on Drawings.
- F. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups as specified herein or as indicated otherwise on the Drawings.
- G. Arrises: Remove the sharp edge from arrises to slightly blunt edge and to reduce chipping of the finished edge.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces indicated to receive masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into masonry are correctly installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Beginning installation means acceptance of existing conditions.

### 3.2 PREPARATION

- A. Clean dirty or stained surfaces by removing soil, stains, and foreign materials before setting. Clean by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

### 3.3 INSTALLATION, GENERAL

- A. 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. Sort masonry units before it is placed to remove units that do not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- B. Arrange as indicated on Drawings.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- D. Set masonry units to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure masonry units in place. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- E. Maintain uniform joint widths except for variations due to different unit sizes and where minor variations are required to maintain bond alignment, if any. Set walls with joints not less than 1/4 inch at narrowest points or more than 1/2 inch at widest points.
- F. Provide sealant joints of widths and at locations indicated.
  - 1. Keep sealant joints free of mortar and other rigid materials.
- G. Place weep holes in joints where moisture may accumulate.
  - 1. Use specified product herein to form weep holes.
  - 2. Space weep holes as indicated on Drawings.

### 3.4 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet or more.
- B. Variation from Level: For joints and lines of coping, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or more.
- C. Measure variation from level, plumb, and position shown in plan as variation of the average plane of the face of each unit from level, plumb, or dimensioned plane.
- D. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

### 3.5 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 ends.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

### 3.6 INSTALLATION OF ANCHORED MASONRY

- A. Set masonry unit in full bed of mortar unless otherwise indicated. Build anchors into mortar joints as unit is set.
- B. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.
- C. Rake out joints for sealant to depth of not less than dimension indicated on Drawings before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

### 3.7 ERECTION TOLERANCES

- A. Variation in Line: Do not exceed 1/8 inch in 96 inches.
- B. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch or 1/4 inch of nominal joint width, whichever is less.
- C. Variation in Surface Plane: Do not exceed 1/8 inch in 10 feet maximum from level or slope  
Variation in Plane between Adjacent Units: Do not exceed 1/32-inch difference between planes of adjacent units.

### 3.8 WALL JOINTING

- A. Refer to Section 042000 Unit Masonry and Section 047200 Calcium Silicate Manufactured Masonry for jointing materials.
- B. Prepare joint surfaces for sealant by removing mortar from joint before it sets and brush clean dust and mortar particles from joint prior to application of sealant.
- C. Tape-off joints to protect the adjacent surface from contact with the sealant and to create a crisp line. Tool joints, with a smooth jointing tool to produce a concave joint profile set just below the face of the masonry unit.

### 3.9 ADJUSTING AND CLEANING

- A. Remove and replace masonry units of the following description:

1. Broken, chipped, stained, or otherwise damaged masonry unit. Unit may not be repaired.
  2. Defective joints.
  3. Masonry units not matching approved samples and mockups.
  4. Masonry units not complying with other requirements indicated.
- B. Replace in a manner that results in masonry units matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement
- C. In-Progress Cleaning: Clean masonry units as work progresses. Remove mortar fins and smears and sealant before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean masonry units as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Landscape Architect's approval of sample cleaning before cleaning masonry units.
  3. Clean masonry units by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.

### 3.10 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Mix and place only that amount of mortar bed that can be covered with cast stone before initial set. Before placing cast stone, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- C. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.
- D. Tamp or beat cast stone with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver or step in a single operation before initial set of mortar; do not return to areas already set or disturb cast stone for purposes of realigning finished surfaces or adjusting joints.
- E. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/16 inch.
- F. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- G. Grout joints as soon as possible after initial set of setting bed.
1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
  2. Clean cast stone as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
  3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

- H. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.11 PROTECTION OF FINISHED WORK

- A. Do not permit construction traffic over unprotected paver surface.

3.12 CLEAN UP

- A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.

END OF SECTION 321500



SECTION 32 16 13.13 - CAST-IN-PLACE CONCRETE CURB AND GUTTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

- A. This Section includes construction of City of Philadelphia Type B Curb.

PART 2 - PRODUCTS

2.1 CAST-IN-PLACE CONCRETE CURB

- A. Concrete: Class A, in accordance with PennDOT Publication 408, Section 704.
- B. Expansion Joint Material: PennDOT Publication 408, Section 705.1.
- C. Cure: PennDOT Publication 408, Section 711.2 (a).

2.2 AGGREGATE BASE

- A. In accordance with PennDOT Publication 408, Section 350.2(a).

PART 3 - EXECUTION

3.1 CAST-IN-PLACE CONCRETE CURB

- A. In accordance with PennDOT Publication 408, Section 630.3 with the following additions:
  - 1. Concrete may be placed in the forms in one lift provided there are sufficient workmen and equipment on the project to thoroughly consolidate the concrete.
  - 2. Cure shall be applied to the top of the curb before any marked dehydration of the concrete surface occurs. The forms shall be removed within 24 hours and all exposed concrete surfaces cured.
  - 3. When directed, the Contractor shall provide additional protection by covering the curb with salt hay at expense of the contractor.

END OF SECTION 321613.13

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SECTION 321623 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

- A. This Section includes construction of Concrete Sidewalks on aggregate subbase.

PART 2 - PRODUCTS

2.1 CONCRETE PAVING

- A. Concrete: Class A, in accordance with PennDOT Publication 408, Section 704.
- B. Aggregate: PennDOT Publication 408, Section 703.2 for Type C or better Number 2A material.
- C. Cure: PennDOT Publication 408, Section 711.2 (a).
- D. Joint Material: PennDOT Publication 408, Section 705.1.

2.2 AGGREGATE BASE

- A. In accordance with PennDOT Publication 408, Section 350.2(a).

PART 3 - EXECUTION

3.1 CONCRETE PAVING

- A. In accordance with PennDOT Publication 408, Section 676.3. The thickness of the sidewalk paving and aggregate shall be as defined in the construction plans.

3.2 AGGREGATE BASE

- A. In accordance with PennDOT Publication 408, Section 350.3.

END OF SECTION 321623

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## SECTION 321724-DECORATIVE 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 installation of pavement marking material into asphalt pavement for the following:
  - 1. Custom Games
  - 2. Double Rowlock
- B. Related Requirements:
  - 1. Section 321216 "Asphalt Paving" for new asphalt pavement.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Using electronic files provided by Landscape Architect of patterns, produce manufacturer drawings for review and approval prior to fabrication.
- C. Samples for Verification: For each color.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Follow manufacturer's recommendations.

## 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. Ennis-Flint, 4161 Piedmont Parkway, Suite 370, Greensboro, NC 27410, 1 (800) 331-8118, [www.ennisflintamericas.com](http://www.ennisflintamericas.com).
- B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - 1. Custom Games: TrafficPatterns Interconnected Surface System. Custom design, provided by Landscape Architect, colors as shown on plan.
  - 2. Double Rowlock: TrafficPatternsXD Impressed Surface System, color as shown on plan.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin imprinting process according to manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING THERMOPLASTIC

- A. General: Install according to manufacturer's written instructions, using manufacturer's recommended equipment.

END OF SECTION 321724

## SECTION 321816 - PLAYGROUND PROTECTIVE SURFACING

### 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. Bonded poured-in-place rubber seamless surface.

- B. Related Sections:

- 1. Section 312000 "Earth Moving" for filling and grading and for drainage course drainage/separation geotextiles and subbase courses.

#### 1.3 DEFINITIONS

- A. Critical Height: Standard measure of shock attenuation. According to CPSC No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."
- B. SBR: Styrene-butadiene rubber.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Impact Attenuation: According to ASTM F 1292.
- B. Accessibility of Surface Systems: According to ASTM F 1951.
- C. US Consumer Product Safety Commission – Public Playground Safety Handbook No. 325.
- D. ASTM F2223 – Standard Guide for ASTM Standards on Playground Surfacing.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for verification: For each type of playground surface system indicated.
  - 1. Minimum 6-by-6-inch Sample of safety pad.
  - 2. Minimum 6-by-6-inch Sample of geotextile.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Extent of surface systems and use zones for equipment.
2. Critical heights for playground surfaces and fall heights for equipment.

D. Qualification Data and Certification: For qualified Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each unitary synthetic playground surface system.

1. Impact/drop test per the requirements of ASTM F1292 to show conformance with the G-Max and HIC criteria listed above. Per ASTM F1292 the impact/drop test shall be performed at the most adverse location on the playground. The impact/drop test shall be conducted by a Certified Playground Safety Inspector (CPSI) who will prepare a certification report of the results. If the surface fails to meet the stated criteria the surface shall be corrected/removed and reinstalled.

F. Field quality-control reports.

G. Closeout Submittals - Warranty: Sample of special warranty.

## 1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A company specializing in the manufacture of products specified in this Section with minimum of three (3) years experience

B. Installer Qualifications: Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with playground safety surface installation and construction techniques under the supervision of an experienced foreperson.

C. Source Limitations: Obtain playground surface system materials from single source from single manufacturer.

D. Provide secondary materials including geotextiles and repair materials of type and from source recommended by manufacturer of playground surface system materials.

E. Standards and Guidelines: Comply with CPSC No. 325, "Handbook for Public Playground Safety"; ASTM F 1292; and ASTM F 1487.

## 1.7 PROJECT CONDITIONS

A. Verify existing conditions in the field prior to start of work. Should Contractor, in the course of work, find any discrepancies between Drawings and physical conditions or any omissions or errors in Drawings, inform Owner immediately in writing for clarification. Work done after such discovery, unless authorized by Owner, shall be at Contractor's risk.

B. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). Do not install in steady or heavy rain.



1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground surface system that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Reduction in impact attenuation.
    - b. Deterioration of surface and other materials beyond normal weathering.
    - c. Deterioration or failure of seams.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Proper drainage is critical to the longevity of the Poured-in-Place surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

PART 2 - PRODUCTS

2.1 POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM

- A. Manufacturer: Surface America, Inc., PO Box 157, Williamsville, NY 14231, (716) 632-8413, or approved equal.
- B. Product: Poured-in-place playground surfacing system as per Manufacturer - Surface America Proprietary Products/Systems, including the following:
  - 1. PlayBound Poured-In-Place Primer:
    - a. Material: Urethane.
  - 2. PlayBound Poured-in-Place Basemat:
    - a. Material: Blend of 100% recycled SBR (styrene butadiene rubber) and urethane.
    - b. Thickness: To be confirmed with fall height of play equipment.
    - c. Formulation Components: Blend of strand and granular material.
  - 3. PlayBound Poured-In-Place Top Surface:
    - a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) rubber and aliphatic urethane binder.
    - b. Thickness: Nominal 1/2" (12.7 mm), minimum 3/8" (9.5 mm), maximum 5/8" (15.9 mm).
    - c. Color A: 50% Purple, 50% Light Gray
    - d. Color B: 50% Sky Blue, 50% Royal Blue
    - e. Dry Static Coefficient of Friction (ASTM D2047): 1.0.
    - f. Wet Static Coefficient of Friction (ASTM D2047): 0.9.
    - g. Dry Skid Resistance (ASTM E303): 89.
    - h. Wet Skid Resistance (ASTM E303): 57.
  - 4. Crushed Stone Base as per Manufacturer recommendations.
    - a. The stone for the base must be crushed so it compacts to a 95% Standard Proctor Compaction (as per A.S.T.M. Test). The stones should be a homogeneous mixture of the following size stones:

Sieve Size	% Passing by Weight
1"	90 - 100
5/8"	50 - 80
1/4"	30 - 50

#4	15 - 35
#8	10 - 30
#30	3 - 5
#200	0 - 3

5. Mixes
- a. Required mix proportions by weight:
- 1) Basemat: 16+% urethane (as ratio: 14% urethane divided by 86% rubber). 14% urethane, 86% rubber (based on entire rubber & urethane mix).
  - 2) Top Surface: 22% urethane (ratio: 18% urethane divided by 82% rubber). 18% urethane, 82% rubber (based on entire rubber & urethane mix).

## 2.2 GEOSYNTHETICS

- A. 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: Class 2; AASHTO M 288.
  2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
  3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
  4. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the playground surfacing manufacturer.

### 3.2 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, subgrade and substrate conditions, drainage, and other conditions affecting performance of the Work.
- B. Verify that play equipment is in place.
1. Begin installation of safety surface immediately upon completion of play equipment installation.
- C. Verify that stone base is ready to receive poured-in-place safety surface.
1. Verify gradients and elevations are correct.
- D. Beginning of installation means acceptance of existing conditions.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. General: Prepare substrates to receive surfacing products according to playground surface system manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

### 3.4 INSTALLATION, GENERAL

- A. General: Comply with playground surface system manufacturer's written installation instructions. Install playground surface system over area and in thickness indicated.
- B. Secure manufacturer's representative to observe all phases of safety surface installation and provide Owner with a written statement certifying compliance with manufacturer's drawings and specifications.
- C. Install safety surface according to manufacturer's instructions and specifications in locations shown on Drawings.
  - 1. Meet or exceed current: CPSC guidelines, ADA guidelines and ASTM F-1292-93 requirements.

### 3.5 GEOSYNTHETIC INSTALLATION

- A. General: Install geosynthetics according to playground surface system manufacturer's and geosynthetic manufacturer's written instructions.
  - 1. Geotextiles: Completely cover area indicated, overlapping sides and edges a minimum of 4 inches (100 mm) > with manufacturer's standard treatment for overlapping loosely laid seams.

### 3.6 POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM INSTALLATION

- A. Crushed Stone Base Installation:
  - 1. The minimum depth of the crushed stone base is 4". Typical thickness range is 4" - 6". Thickness is never to exceed 10".
  - 2. The crushed stone base should be sloped 2% to allow run-off of the excess water that doesn't percolate through the crushed stone.
  - 3. The crushed stone base must be thoroughly compacted by using a tamper, roller or combination of both to a 95% compaction rate throughout the base.
- B. Basemat Installation:
  - 1. Using screeds and hand trowels, install the basemat at a consistent density of 29 pounds, 1 ounce per cubic foot (466 kg/m<sup>3</sup>) to the specified thickness indicated on drawings.
  - 2. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foot traffic or equipment.
  - 3. Do not allow foot traffic or use of the basemat surface until it is sufficiently cured.
- C. Primer Application: Using a brush or short nap roller, apply primer to the basemat perimeter and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 ft<sup>2</sup>/gal (7.5 m<sup>2</sup>/L).
- D. Top Surface Installation:
  - 1. Using a hand trowel, install top surface at a consistent density of 58 pounds, 9 ounces per cubic foot (938 kg/m<sup>3</sup>) to a nominal thickness of 1/2" (12.7 mm).
  - 2. Allow top surface to cure for a minimum of 48 hours.
  - 3. At the end of the minimum curing period, verify that the top surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
  - 4. Do not allow foot traffic or use of the surface until it is sufficiently cured.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of completed applications of playground surface system shall take place according to ASTM F 1292.
- C. Remove and replace applications of playground surface system where test results indicate that it does not comply with requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with requirements.

3.8 CLEAN UP

- A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.

END OF SECTION 321816

## SECTION 323113 – CHAIN-LINK FENCING AND GATES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Chain-link fences and swing gates.
- B. Related Sections:
  - 1. Division 2 Section "Earthwork".
  - 2. Division 2 Section "Tree Protection and Trimming".
  - 3. Division 2 Section "Asphalt Paving".
  - 4. Division 2 Section "Site Concrete".

#### 1.3 REFERENCES

- A. The following apply to work in this Section:
  - 1. ASTM: Specifications of the American Society for Testing and Materials latest editions. Modifications specified herein shall govern where conflicts with ASTM standards occur.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements, meeting PPR standard requirements, and design criteria indicated.
- B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Minimum Post Size: As per Manufacturer's Recommendations.
  - 2. Minimum Post Size and Maximum Spacing: As per Manufacturer's Recommendations.
    - a. Fence Height: Refer to Drawings.
    - b. Material Group: IA, ASTM F 1043, Schedule 40 steel pipe.

#### 1.5 SUBMITTALS

- A. Product Data: Submit product literature or tear sheets with name of product and manufacturer. Fence and gate posts, rails, fittings, and locks. Confirm that gate locking mechanism works with PPR preferred locking system.
  - 1. Chain-link fences and gates.
- B. Product Test Reports: For framing strength according to ASTM F 1043.
- C. Field quality-control reports.
- D. Warranty: Sample of warranty.

1.6 QUALITY ASSURANCE

- A. Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with playground, chain link fence installation and construction techniques under the supervision of an experienced foreperson.
- B. Manufacturer: Company specializing in the manufacture of chain link fences with minimum three (3) years experience.

1.7 REGULATORY REQUIREMENTS

- A. Comply with all rules, regulations, laws and ordinances of local, state and federal authorities having jurisdiction. Provide labor, materials, equipment and services necessary to make work comply with such requirements without additional cost to Owner.
  - 1. Coordinate work with utility companies. Notify Pennsylvania One Call System, Inc. 1-800-242-1776 not less than three working days prior to beginning work.
- B. Investigate the conditions of public thoroughfares and roads as to availability, clearances, loads, limits, restrictions and other limitations affecting transportation to and ingress and egress at the site.
  - 1. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.
- C. Conform to applicable code for disposal of debris.
- D. Procure and pay for permits and licenses required for work.

1.8 DELIVERY STORAGE AND HANDLING

- A. Deliver, store, handle and protect all materials from damage.

1.9 PROJECT 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.
- B. Should any work performed under this Section expose previously unknown conditions, immediately report the discovery to Architect. However, during this time use any measures necessary to maintain adequate safety conditions.
  - 1. Should Contractor, in the course of work, find any discrepancies between Drawings and physical conditions or any omissions or errors in Drawings, inform Architect immediately in writing for clarification. Work done after such discovery, unless authorized by Owner, shall be at Contractor's risk.

1.10 WARRANTY

- A. Warranty: Manufacturer's standard form in which 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. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

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

## PART 2 - PRODUCTS

### 2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvaige knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated.
- B. Manufacturer: Master Halco – 3010 Lyndon B Johnson Freeway, Dallas TX, [www.masterhalco.com](http://www.masterhalco.com), or approved equal.
- C. Fence fabric mesh size, gauge per Drawings.
1. Thermally fused vinyl coated steel chain link fence ASTM F668- Type 2B with a galvanized steel core in accordance with ASTM A-641-71A. Color Black.

### 2.2 FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on Drawings. Coating to match chain link fence fabric. Color Black.

### 2.3 FITTINGS

- A. General: Comply with ASTM F 626. Provide coating to match chain link fence fabric.
- B. Post Caps: Provide for each post.
1. Provide line post caps with loop to receive top rail.
- C. Rail and Brace Ends: For each corner and end post.
- D. Rail Fittings: Provide the following:
1. Top Rail Sleeves: Round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Hot-dip galvanized rod and turnbuckle or other means of adjustment.
- H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
- a. Hot-Dip Galvanized Steel: 0.106-inch diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
- I. Gate Hardware:
1. Hinge: 180 degree.
2. Mechanism to latch gate in open position to fence.

3. Gate Locking Mechanism approved by PPR.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance 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 or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

#### 3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

#### 3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. 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.
- C. Terminal Posts: Locate terminal end, and corner posts per ASTM F 567
- D. Line Posts: Space line posts per Drawings.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. 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 mid-height of fabric 72 inches or higher, on fences with top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch diameter hog rings of same material and finish as fabric wire, spaced per Drawings. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
  1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.



- G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps 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: Install and secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches 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. 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 per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing. Each end of wire tie shall be wrapped around fabric at least 540 degrees.
  - 1. Maximum Spacing: Tie fabric to line posts at dimension indicated on Drawings.

### 3.5 CLEAN UP

- A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.

END OF SECTION 323113

## SECTION 329000 – PLANTINGS AND SEEDING

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The work of this Section includes furnishing all labor, materials, equipment and incidentals required to complete all planting related landscaping work indicated on the Drawings and as specified herein, including but not necessarily limited to the following;
1. Excavation for plantings.
  2. Furnishing and installing plant materials as shown on the Drawings, including shrubs, trees, and perennials.
  3. Mulch, fertilize, stake, and prune all plants and trees.
  4. Watering all specified plants.
  5. Final cleanup and all other work required to complete the job in accordance with the Drawings and Specifications.
  6. Preparation of as-planted sketch plans.
  7. Maintenance of all specified plants and trees for an 8-week maintenance period.
  8. Monthly planting status reporting of completed planted and maintenance activities.
  9. Provision of "As Planted" record drawings.
  10. Plant and tree warranties.

#### 1.2 REFERENCE STANDARDS

- A. American Association of Nurserymen (AAN)
- B. ANSI Z60.1 - American Standard for Nursery Stock, most current edition
- C. ANSI A 300 - Standard Practices for Tree, Shrub, and other Woody Plant Maintenance, most current edition and parts.
- D. Soil Science Society of America (SSSA) Methods of Soil Analysis, Parts 1, 2, 3 & 4
- E. American Society of Agronomy (ASA)
- F. Other Agencies
1. American Society of Testing and Materials (ASTM)
    - a. ASTM A 641/A 641M - Galvanized-steel wire
    - b. ASTM B 221, Alloy 6063-T6, Aluminum Edging
    - c. ASTM D5539-94 – Standard Specification for Seed Started Mix
  2. Association of Official Agricultural Chemists (AOAC)
  3. Woods End Research Laboratory, Solvita compost maturity index test.
  4. International Society of Arboriculture (ISA)
  5. PWD GSI Landscape Design Guidebook recommended plant list (Fall Update)
  6. Philadelphia Parks and Recreation (PP&R - previously Fairmount Park Commission) Recommended Street Tree List
  7. PP&R Contractor Guidelines.
  8. USDA Rules and Regulations under the Federal Seed Act
  9. Philadelphia Streets Department, Standard Construction Items.
  10. Pennsylvania Department of Transportation, Form 408 Specifications.

- G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

### 1.3 SUBMITTALS

- A. Submit complete product data for all materials furnished under this Section. One set of complete submittals is required per planting season. Any changes to materials require resubmittal. Unless otherwise noted below, all submittals must be received at least three (3) months prior to the start of the upcoming planting season.
- B. Submit qualifications of crew, equipment, and suppliers using the Landscaping Qualifications Form in Appendix F. Qualifications must conform to the requirements detailed in Section 1.06, Contractor Qualifications, below.
- C. Samples, testing and certifications of all materials shall be submitted for inspection and acceptance upon Owner's request. None of the landscaping materials shall be delivered to the site until samples and test results are approved by Owner/Authorized Representative, however such approval does not constitute final acceptance.
  - 1. Mulch: Submit [1-quart] volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
- D. Submit a schedule for planting at least three (3) months prior to the start of the upcoming planting season. Schedule shall conform to planting seasons as defined in these Specifications and take into account allotted days for completion of the Work in the Contract; any extensions of the time allotment to be made for accommodation of planting seasons may be made at the sole discretion of a Project Manager.
- E. Submit a proposed list of plant species with botanical and common names, variety, size, quantity, and source of plant materials in the varieties, sizes, and quantities indicated on the Drawings at least three (3) months prior to the start of the upcoming planting season. Sources of planting materials must be confirmed by the Contractor and written documentation of plant availability in accordance with the submitted planting schedule shall be provided by the supplier(s).
- F. Plant Substitutions for plants not available locally should be ordered from nurseries located out of the state. Substitutions may be permitted only after substantiated written confirmation and documentation is submitted that a specified plant is either not obtainable or is not recommended for the location as shown on the landscaping plan. Substitutions should be drawn from the recommended plant list included in the PWD GSI Landscape Design Guidebook.
- G. The Contractor must provide to a Project Manager each of their plant supplier's shipping lists for review and approval after ordering, but prior to supplier's shipping any plant material. Only specified plant species will be accepted. No cultivated varieties (cultivars) are acceptable.
- H. The Contractor shall be required to submit status reports to Owner/Authorized Representative on a monthly basis during planting and maintenance activities. Photographic documentation as detailed in Section 01110 (Photographic Documentation) shall be provided as part of each status report. A template for the Project Status Report is appended to these Specifications.
- I. Submit Monthly Project Status Reports using the template in Appendix D. Project Status Reports shall list detail all planting, maintenance activities, and upcoming site work. Photographic documentation shall be included with the Monthly Project Status Report in accordance with

Section 01110 (Photographic Documentation) of these Specifications. Project Status Reports shall be submitted within one (1) week of the end of each month.

- J. Sketch plans, photographs, and written documentation of all plant installations, including initial planting and any plant replacements during the eight (8)-week maintenance period shall be submitted for approval within one (1) week of provisional acceptance subsequent to the maintenance period.
  - 1. Sketch plans must include a revised schedule with species (botanical name) and cultivars and final quantities along with a revised planting plan.
  - 2. Landscape sketch plans may be a markup of the original landscaping plan. Changes to the original landscaping plan shall be clearly noted and shown in red.
  - 3. All sketches shall be labeled “As Planted”, dated, and shall contain the name or initials of the Designer.

#### 1.4 CONTRACTOR QUALIFICATIONS

- A. Crew Requirements: Crews shall consist of a minimum of two workers. One (1) landscape foreperson shall be present at all times during execution of the work. The foreperson shall direct all work performed under the following sections. Notify the Department of the name and phone number of crew member with credentials outlined below, along with a contact phone number, at least five (5) business days in advance of the first day of the specified activity.
  - 1. The foreperson shall have experience with at least five (5) landscape installations of similar scope and complexity and shall have a minimum of three (3) years of experience in successful completion of similar landscape installation work. The Vendor must submit a resume of the foreperson(s) who will supervise the work crew(s).
  - 2. All crew certification documentation should be readily available onsite so Owner/Authorized Representative can confirm certifications during site inspections.
  - 3. Multiple certifications can be held by an individual crew member to satisfy the requirements set for in these Specifications.
- B. Pesticide applications: No pesticides shall be applied unless approved in writing by the Owner. For pesticide applications, one (1) crew member must have certification as a Pest and Disease Applicator, Pennsylvania State licensed, certified commercial applicator, category: Ornamental and Shade Trees, Lawn and Turf. This crew member shall be required to be present during application of pest and disease control practices. The Vendor must submit the Pesticide and Disease Applicator’s License IDs for employees performing pest and disease control.
  - 1. The Vendor must submit a resume of the employee(s) who will supervise the work crew(s).
  - 2. All crew certification documentation should be readily available onsite so Owner/Authorized Representative can confirm certifications during site inspections.
  - 3. Multiple certifications can be held by an individual crew member to satisfy the requirements set for in these Specifications.

#### 1.5 QUALITY ASSURANCE

- A. All plant materials shall be tagged and approved by the Owner prior to site delivery. The Contractor shall notify Owner/Authorized Representative of planting and tagging days a minimum of seven (7) days prior.
- B. Each plant or same-species group of plants shipped to the job site must be clearly labeled with its scientific name and common name. The Contractor is responsible to check to see that the plants are correctly labeled. Owner/Authorized Representative will not accept improperly labeled plants. The Contractor is prohibited to add, alter or remove labels. The Contractor will not be paid

for material that is improperly labeled or for material on which the Contractor has altered or removed the labels.

## 1.6 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 (“root ball”), with a ball size not less than the 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. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than the diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. 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.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. Finish Grade: Elevation of finished surface of planting or stormwater soil.
- H. Multi-stem trees: Trees that shall have three or more main stems that arise from the ground from a single root crown or at a point just above the root crown.
- I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- J. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- K. Planting Area: Areas to be planted.
- L. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- M. 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.

- N. Plugs: A cylinder of medium in which a plant is grown. The term is generally used to describe seedlings and rooted cuttings which have been removed from the container but with the medium held intact by the roots.
- O. 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.
- P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- Q. Stormwater Soil: A planting soil mixture intended to provide water quality management by filtering stormwater runoff and provide sufficient infiltration for management of specified quantities of surface water flows.
- R. Subgrade: Surface or elevation of subsoil remaining after completing excavation or backfill immediately beneath planting soil or lightweight fill material , that is integrated with Specified Soil or Growing Media by tilling in a layer of Transition Mix.

#### 1.7 INSPECTION OF PLANT MATERIALS

- A. Owner/Authorized Representative may observe plants and trees at supplier before delivery to site for compliance with requirements for genus, species, variety, size, and quality. Owner/Authorized Representative reserves the right to be present for inspection of plants at nursery and may attach their seal to each plant. The Contractor is responsible for paying any up charge for Owner/Authorized Representative to attach their seal to specific plants.
- B. Owner/Authorized Representative shall be present at time of delivery to inspect plants and trees delivered to the site. A Project Manager retains the right to inspect or reject substandard plants or trees for size and condition of balls and root systems, insects, injuries, latent defects, and speciation, and to reject unsatisfactory or defective material at any time during progress of work. Rejected plants and trees must be removed immediately from the project site.
- C. The Contractor shall stake the plant layout for approval by Owner/Authorized Representative. No plants or trees may be planted without on-site approval by Owner/Authorized Representative.
- D. All trees shall be labeled by tree name (genus, species, and cultivar), and all labels securely attached to individual trees upon delivery to the jobsite.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall confine the storage of material and equipment to locations approved by Owner/Authorized Representative.
- B. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- C. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Accompany each delivery of bulk materials with appropriate certificates.

- D. Materials shall not be dropped or dumped from vehicles. Materials shall be reviewed for compliance with specified requirements. Unacceptable materials shall be removed and disposed from the job site. Materials shall be stored in designated areas.
- E. Deliver plants freshly dug. Do not prune trees and shrubs, except as directed by Owner/Authorized Representative. Protect bark, branches, and root system from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during delivery. Carefully handle all trees and shrubs during delivery to avoid mechanical damage. Handle all planting stock by the root ball. After delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during shipping and storage.
- F. Roots of plants shall be adequately protected at all times from sun and from drying winds.
- G. Plants which cannot be planted immediately upon delivery shall be set on the ground, out of direct sun if possible, and be well-protected with soil, mulch, or other acceptable material. Plant materials shall not be stored on site for more than two (2) days prior to planting. It is the Contractor's responsibility to keep plants watered and maintained upon delivery to site; give plants enough water so that the entire soil mass is wet and water is draining out the pot bottom. Secure plants from theft and vandalism.
- H. No tree shall be planted if the root ball is cracked, broken, or dropped either before or during the planting process. No container plants will be accepted if the container is cracked or broken except upon special approval of Owner/Authorized Representative.
- I. Deliver plants on day of installation after preparations for installation have been completed. A Project Manager shall be onsite to approve condition and speciation of delivered trees and plant layout.

#### 1.9 PROJECT CONDITIONS

- A. Restrictions: Planting shall only be performed during the periods within the seasons which are normal for such work as determined by weather and by locally acceptable practice and which are approved by Owner/Authorized Representative. No planting shall be performed between acceptable planting periods unless otherwise approved by Owner/Authorized Representative. The Contractor shall schedule his work to conform to these requirements. Planting close to the end of the season should be avoided if possible to maximize favorable planting conditions.
  - 1. Spring Planting: March 15 – June 15.
  - 2. Fall Planting: September 15 – December 15.
- B. Weather Limitations: Proceed with planting activities 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 and according to manufacturer's written instructions. Owner/Authorized Representative reserves the right to postpone planting activities due to unfavorable weather conditions.
  - 1. During periods of drought, irrigation shall be provided as approved by Owner/Authorized Representative. Water rates shall be equivalent to one inch (1") of rainfall per week.
- C. Access over finished grade soils shall be restricted. If access is required across placed soils, Contractor shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils as directed by Owner/Authorized Representative.

1.10 SITE ACCESS

- A. For each of the different areas where the Contractor needs to gain access to perform his work, the Contractor shall make arrangements with the Owner in advance to access the site. These arrangements may require the construction of temporary roadways or bridges and the removal and replacement of existing structures.

1.11 EXISTING STRUCTURES AND PAVING

- A. It is expected the Contractor will prepare their own preconstruction documentation in addition to the City's own photographs, to verify the original site conditions and the immediate vicinity of the project areas. The Contractor shall provide a set of preconstruction photographs to the Owner/Authorized Representative.
- B. Any disturbed paving or curb, footway or driveway shall be restored according to any instructions provided by the Philadelphia Streets Department. All disturbed surfaces outside of the Streets Department restoration area shall be restored in kind.

1.12 MAINTENANCE SERVICE

- A. Project Maintenance: Provide maintenance of planted areas by skilled employees of the landscape installer as defined under quality assurance above. Maintain as required in Part 3 herein. Begin maintenance immediately after plantings are installed and continue for an eight (8) week period.

1.13 INSPECTION FOR PLANTING CERTIFICATION

- A. Planting certification for provisional approval shall be determined by Owner/Authorized Representative on a site by site basis. Certification shall verify that the plants are in healthy condition at the time of inspection, that the planting methodology appears correct, and that the plants should be expected to survive as installed by the Contractor. Certification shall be made by a designee of the Owner that has experience locally installing native plants of similar types used in the project. Individual plantings or entire areas or species may be rejected at this time for certification. Owner/Authorized Representative reserves the right to determine remediation required in the event of non-certified plantings, up to and including full replacement.
- B. A Project Manager will perform inspection on a site by site basis at the end of the eight (8)-week maintenance period and upon the written request of the Contractor received at least ten (10) calendar days before the anticipated date of inspection.
- C. At the end of the maintenance period, the Contractor shall be responsible for replacement planting for any plants that are missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by Owner/Authorized Representative. Any determination made by a Project Manager regarding plant replacement shall be final, and the Contractor shall be responsible for replacing the plantings in kind (unless otherwise directed) as soon as weather conditions permit during the next appropriate planting season at no additional cost to the City. The Contractor shall not be responsible for damage or plant mortality due to vandalism.
- D. The Contractor shall prepare a list of items to be completed or corrected for review by Owner/Authorized Representative. Upon completion of the inspection, Owner/Authorized Representative shall amend the list of items to be completed or corrected. Corrective work shall be completed within two (2) weeks of receipt of the list of items needing correction or completion.



- E. The eight (8)-week maintenance period must reoccur if any replacement of plants is required the time of inspection.
- F. After all necessary corrective work has been completed and approved by Owner/Authorized Representative subsequent to required maintenance period(s), Owner/Authorized Representative shall certify in writing the planting certification and the one-year warranty period will commence.
- G. Should approval of work be delayed after the end of the maintenance period(s) has elapsed, the Contractor shall continue maintenance activities until such approval is granted.

#### 1.14 WARRANTY PERIOD AND REPLACEMENTS

- A. The Contractor shall warranty that plant material is properly handled and installed. The Contractor shall be responsible for replacement planting required for a period of twelve (12) months after a planting is certified. At the end of the warranty period, plants that are missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by Owner/Authorized Representative, shall be replaced within the quantity limits set forth in section 1.16.D below. Any determination made by a Project Manager regarding plant replacement shall be final, and the Contractor shall be responsible for replacing the plantings in kind (unless otherwise directed) as soon as weather conditions permit during the next appropriate planting season at no additional cost to the City. The Contractor shall not be responsible for damage or plant mortality due to vandalism.
- B. All replacement of plants and trees shall be conducted in accordance with the material and construction (including schedule) in these Specifications.
- C. Replace any trees or shrubs that are more than twenty-five percent (25%) dead or in unhealthy condition at end of warranty period, as determined by Project Manager. Reseed herbaceous cover that is less than eighty-five percent (85%) alive at end of warranty period.
- D. Plant replacements for all plants installed during a planting season, across all sites under the contract, shall be limited to the following quantities at the end of the warranty period:
  - 1. 20% of trees
  - 2. 20% of shrubs
  - 3. 20% of herbaceous cover
  - 4. Additional replacements may be required from installation to the end of the provisional maintenance period should plants not survive.

#### 1.15 FINAL INSPECTION AND FINAL ACCEPTANCE

- A. At the end of the warranty period, final inspection will be made by a Project Manager. Owner/Authorized Representative will request the Contractor to attend the site inspection at least ten (10) calendar days before the anticipated date of inspection.
- B. Upon completion of the inspection, Owner/Authorized Representative shall provide a list of items to be completed or corrected. Corrective work shall be completed within two (2) weeks of receipt of items needing correction or completion.
- C. After all necessary corrective work has been completed, a Project Manager will certify in writing the final acceptance of planting.

## PART 2 - PRODUCTS

### 2.1 PLANT CONDITIONERS

- A. Herbicide application is not permitted for school planting. All weeding shall be performed manually.
- B. Water used in this work shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.
- C. The use of hydrogels (in soil mixes or directly applied to plant roots) is prohibited in any green stormwater infrastructure system.

### 2.2 PLANT MATERIALS

- A. Furnish and install plants, and pre-tagged and approved trees, as shown on the Drawings and specified herein. Plants shall be nursery grown under climatic conditions similar to those in the locality of the project and shall conform to the variety and sizes indicated. Plant material not obtained from an approved source is prohibited.
- B. Plants shall conform to the indicated botanical names and standards of size, culture and quality for the highest grades and standards as adopted by the ANSI Z60.1 - American Standard for Nursery Stock. All plants shall meet specified sizes and be provided as plugs, container grown, field potted, or field balled and burlapped materials as specified.
  - 1. All single-stem trees must have a straight trunk, well-balanced crown, and intact leader. Branching height (height of the lowest living branch) must be one-third to one-half ( $\frac{1}{3}$  -  $\frac{1}{2}$ ) of tree height. Shrubs must be multi-stemmed with a well-balanced crown.
  - 2. Tree measurements should be taken with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree for height and spread; do not measure branches or roots tip to tip. Take caliper measurements six inches (6") above root flare for trees up to four-inch (4") caliper size and 12 inches (12") above the root flare for larger sizes.
  - 3. All trees are to be a minimum of two inches (2") caliper and balled and burlapped, or as specified in the landscaping drawings. Shrubs must be in a three (3) gallon container minimum and at least three to four feet (3-4') feet tall, or as specified in the landscaping drawings.
  - 4. All container grown materials shall be grown to specified size in a container and shall be healthy, vigorous, well rooted and established in the container in which they are growing. A container grown plant shall have a well-established root system reaching the sides of the containers to maintain a firm root ball, but shall not have excessive root growth encircling the inside of the container.
  - 5. Plugs shall be cut into square or round plugs, strongly rooted, and capable of vigorous growth and development when planted; Plug Size: three (3) inches
  - 6. Measure plant materials with stems, petioles, and foliage in their normal position. Plants shall be of sufficient dimensions to include most of the fibrous roots and conforming to the standards of the AAN and ANSI Z60.1.
- C. Plants shall be freshly dug for delivery. No heeled in plants or plants from cold storage shall be accepted. All plants shall be sound, healthy, well branched, and free of disease or pests. Plants shall be free of physical damage such as bark abrasions, disfiguring knots, sunscald, or unhealed

cuts over three-quarters of an inch ( $\frac{3}{4}$ " ). Trees with multiple leaders shall not be accepted. Plants or trees with girdling root systems shall not be accepted.

- D. Plants larger than those shown in the planting schedule on the Drawings may be used, if approved by a Project Manager, but use of such plants shall be at no additional cost to the Owner. If the use of larger plants is approved, the spread of roots or ball of earth shall be increased in proportion to the size of the plant as approved and in accordance with ANSI Z60.1.
- E. All plants shall be grown on their own roots. Grafted materials are only acceptable if grafted at least twelve (12) months before use, unless otherwise specified.
- F. Plant material not obtained from an approved source is prohibited

## 2.3 TREES

- A. In accordance with the design plans.

## 2.4 SEEDING

- A. Seeding on the site shall be one of the following design mixes:
  - 1. Drought Defy "Diamond Quality Mix" as manufactured by Reed and Perrine, 396 Main Street, Tennent, NJ, 732-446-6363:
    - a. 35% Titanium LS Tall Fescue
    - b. 35% Raptor II Tall Fescue
    - c. 20% GrandSlam II Perennial Rye
    - d. 10% Zinger Kentucky Bluegrass
  - 2. "Sports Turf Mix" as manufactured by The Turf Trade, 517 Franklinville Road Mullica Hill, NJ 08032, 856-478-6704:
    - a. 40% Turbo Tall Fescue
    - b. 40% Hemi or Bullseye Tall Fescue
    - c. 10% Octane or Secretariate 2 Perennial Ryegrass
    - d. 10% Fusion Perennial Ryegrass
  - 3. "Advantage Mix" Tall Fescue/Rye Mix (80/20) as manufactured by Fisher and Son, 110 Summit Drive, Exton PA 19341, 1-800-262-2127:
    - a. 50% Inferno Tall Fescue
    - b. 30% Quest Tall Fescue
    - c. 10% Revenge GLX Perennial Ryegrass
    - d. 10% Replay Perennial Ryegrass

## 2.5 MULCH

- A. Organic mulch shall be double-shredded well-composted, hardwood bark, aged six (6) months to one year. Size shall be a maximum width or length of two inches (2") and a minimum of a half inch ( $\frac{1}{2}$ " ) in width or length. Mulch shall be free of wood chips, stones or other undesirable matter. Mulch shall be natural hardwood color. Dyes shall not be permitted.
  - 1. Source: The Contractor is reminded that mulch generally meeting these requirements is available for purchase from the Fairmount Park Organic Recycling Center, 3850 Ford Road, Philadelphia, (215) 685-0108.
  - 2. Other supplier conforming to organic mulch requirements above.

2.6 WEED-FREE STRAW AND SALT HAY

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.7 TREE WRAP

- A. Contractor shall not use tree wrap on trees unless specifically directed by Owner/Authorized Representative. Where directed by Owner/Authorized Representative, tree wrap shall be a woven polypropylene fabric. When used, tree wrap shall be installed on each tree immediately after planting.

2.8 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
  1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
  2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
  3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes.
  4. 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.
  5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

2.9 EROSION CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a 100% biodegradable mesh. Include manufacturer's recommended steel wire staples, six (6) inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb./sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, six (6) inches long.

2.10 WATER

- A. Water used in this work shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.
- B. The use of hydrogels (in soil mixes or directly applied to plant roots) is prohibited in any green stormwater infrastructure system.

PART 3 - EXECUTION

3.1 GENERAL

- A. Planting, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by Owner/Authorized Representative and set forth in Section 1.10 herein.

- B. Protect adjacent and adjoining structures, utilities, walks, pavements, fences and other facilities, trees, shrubs, mulched beds, plantings, and mulched areas from damage caused by planting operations. Any damages to infrastructure shall be repaired by the Contractor at no cost to Owner.
- C. Schedules for planting shall be submitted to Owner/Authorized Representative for approval at least three (3) months prior to the start of the upcoming planting season. The Contractor shall notify Owner/Authorized Representative of plant tagging and planting days with a minimum of seven (7) days' notice. In the event of inclement weather, planting should occur when conditions permit. In the event of rain, specifically, planting should occur the following day.
- D. The Contractor shall stake out locations of trees and secure approval of layout prior to planting.

### 3.2 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance of the Work.
  - 1. The Contractor shall review details of existing subsurface infrastructure to ensure digging or staking does not damage existing infrastructure. Contractor is responsible for costs to repair any damage to subsurface infrastructure caused by planting or staking operations.
  - 2. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 3. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
  - 4. Review details of subsurface infrastructure to ensure digging or staking does not interfere with other assets.
  - 5. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 6. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Project Manager and replace with new stormwater soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, other facilities, trees, shrubs, mulched beds, plantings, turf areas, and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. All plants shall be installed at locations as shown on the Drawings. The Contractor shall stake out locations, outline areas, and obtain a Project Manager's approval of layout before excavating or planting. Make minor adjustments as required.

### 3.4 MINOR GRADING AND FILL

- A. See Section 334003 for requirements of placement and grading of planting and stormwater soils.

- B. The addition of soil may be required given the condition of the site as directed by Owner/Authorized Representative. Minor grading shall take place following the addition of soil, or as deemed necessary by Owner/Authorized Representative.
- C. Protect newly graded soils from traffic, freezing and erosion. Keep soils free of trash, debris or construction materials from other work.
- D. Repair and re-establish grades to specified tolerances where completed surfaces become eroded, rutted, settled, or over compacted due to subsequent construction operations or weather conditions.
- E. Scarify or remove and replace material to a depth as directed by Owner/Authorized Representative.
- F. Where settling occurs, before final acceptance, remove mulch and backfill with additional approved soil, compact to specified density.
- G. Finished grades to be landscaped or seeded shall include a minimum stormwater layer of six inches (6"). Finished grades to be otherwise surfaced shall allow sufficient elevation for the completed surface to produce the finished grades and elevations as shown on the Drawings.

### 3.5 PLANTING OPERATIONS

- A. Planting shall be done by experienced workmen familiar with planting procedures under the supervision of a qualified foreman.
- B. The Contractor shall make all efforts to not destroy soil structure by excessive traffic, working, or compacting the soil throughout the planting operation. Utilize the smallest practicable piece of low ground pressure mechanical equipment in the adjacent areas.
- C. To prevent potential for plant settlement, do not over-excavate prior to planting.
- D. Stormwater soil shall be backfilled in lightly compacted layers of not more than nine inches (9") and each layer watered sufficiently to settle before the next layer is put in place.
- E. If more than two (2) days elapse following preparation of stormwater soil, then the Contractor shall be responsible for regrading and loosening areas before planting.
- F. Plants which cannot be planted immediately upon delivery shall be set on the ground, out of direct sun when possible, and be well-protected with soil, mulch, or other acceptable material. Plant materials shall not be stored on site for more than two (2) days prior to planting. It is the Contractor's responsibility to keep plants watered and maintained upon delivery to site; give plants enough water so that the entire soil mass is wet and water is draining out the pot bottom. Secure plants from theft and vandalism.
- G. Owner/Authorized Representative reserves the right to reject a plant or group of plants at any time during the project.

### 3.6 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches
  - 1. Excavate circular planting pits with sides sloping inward at a 45-degree angle where possible, or as indicated in planting detail drawings. Trim perimeter of bottom leaving

- center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for planting stock where possible, or as indicated in tree planting detail drawings.
  3. For bare root stock, excavate at least 12 inches wider than root spread or as indicated on the drawings, whichever is the greater dimension and deep enough to accommodate vertical roots.
  4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling; the root flare must be visible for planted trees.
  6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  7. Maintain supervision of excavations during working hours.
  8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
  9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Topsoil, planting soil, or stormwater soil removed from excavations may be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Owner/Authorized Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations
1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage:
1. Notify Project Manager/Contracting Officer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
  2. Verify by testing that pits are free draining. If pits are not free draining notify Owner/Authorized Representative and submit alternative method of drainage for approval
- 3.7 INSTALLATION OF TREES AND CONTAINER SHRUBS
- A. Remove all debris from the pit and tamp loose soil in the bottom of the pit by hand.
  - B. Do not handle the plant by the trunk, branches, leaves or stem.
  - C. Place the plant straight in the center of the planting pit, carrying the plant by the root mass.
  - D. Carefully cut and remove all of the wire baskets that are packaging the root system using the least amount of disturbance as possible.
  - E. Cut and remove all ropes around the burlapped ball. Remove all nails. Remove all burlap, wires, and/or other materials from the planting hole.
  - F. When planting container plants, scarify the sides and bottom of the root mass such that no roots continue to circle around the root mass. When possible, pull encircling roots away from root mass

and position them in the soil around the planting hole such that they are being pulled away from the plant.

- G. Backfill planting pit with soil and tamp firmly to fill all voids and air pockets. Do not over compact soil (backfilled soil should have a maximum bulk density of 1.5g/cm<sup>3</sup>). Make sure plant remains straight during backfilling/tamping procedure.
- H. The top of the root mass of the trees/shrubs should be flush with, or slightly elevated (no more than 1/8th its height) above the final grade. Do not cover stem with soil or mulch.
- I. When planting on a slope, plant “out-of-the-hill” by raising the grade around the planted hole so it is flat at the surface. Do not plant “into-the-hill” by lowering the grade and do not leave the grade at an angle.
- J. Water plants thoroughly at their bases immediately after planting to saturate backfill. Watering shall occur of a sufficient quantity to saturate the backfill and shall be applied slowly enough to sink into the soil avoiding runoff.
- K. Install slow-release watering bags on all trees such as Treegator or equivalent with at least 15 gallon capacity. Fill watering bags during maintenance.
- L. A layer of mulch should be placed around each tree and shrub installed as set forth in herein and as indicated in planting detail drawings.
- M. The Contractor shall leave no open planting pits at the close of each day.
- N. A woven polypropylene tree wrap shall be used to protect trees from deer damage if so directed by Owner/Authorized Representative. Tree wrap shall be installed on each tree immediately after planting.
- O. Maintain protection of trees during installation and maintenance periods. Treat, repair or replace any damaged planting.
- P. During planting, all areas shall be kept neat, clean and free of all trash and debris, and all reasonable precautions shall be taken to avoid damage to existing plants, turf, structures, and private property.
- Q. Remove all tags, labels, strings and wire from the plant materials, unless otherwise directed by Owner/Authorized Representative.
- R. Promptly remove soil debris created by work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other paved areas.
- S. Final cleanup shall be the responsibility of the Contractor and consist of removing all trash and materials incidental to the project and disposing of them off-site.
- T. When planting on side slopes, grade shall be raised to provide a level surface for planting.

### 3.8 PROTECTION OF TREES

- A. Refer to section 015639 for Tree Protection requirements.



### 3.9 TREE REMOVAL

- A. Refer to section 015639 for Tree Removal requirements.

### 3.10 TRIMMING AND PRUNING

- A. Each plant shall be trimmed in accordance with AAN and ANSI Z60.1 standards to preserve the natural character of the plant and as directed by Owner/Authorized Representative.
- B. Trimming and pruning shall be done with clean, sharp tools.

### 3.11 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
  - 1. Place stakes as low as possible, no higher than 2/3 the height of the tree.
  - 2. Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
  - 3. Materials used to tie the tree to the stake should be flexible and allow for movement all the way down to the ground so that trunk taper develops correctly.
  - 4. Support trees with bands of flexible ties at contact points with tree trunk. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Trunk Stabilization by Staking and Guying: Stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated. Install trunk stabilization as follows:
  - 1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.
    - a. Securely attach guys to stakes 30 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
    - b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
    - c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
    - d. Attach flags to each guy wire, 30 inches above finish grade.
    - e. Paint turnbuckles with luminescent white paint.
- C. No staking shall be performed without full understanding of subsurface infrastructure locations.

### 3.12 INSTALLATION OF CONTAINER PLANTS

- A. Install plants after stapled erosion control blanket is installed and approved by a Project Manager (where applicable). When stapled erosion control blanket is approved, dig a hole for each plug or plant that is about the same depth as the soil of the plug or potted plant. For plugs, a 'dibble bar' with the same diameter as the plug can be used to create the hole, when punched through the blanket. For container plants, the stapled erosion control blanket shall be cut in a circular hole shape to match the diameter of the container.
- B. Remove the plants and soil from the pots and carefully break apart bound root balls. Position each plant in its hole so that the soil level of each plant is flush to the surrounding finished grade

soil surface. After planting, fill soil in around the plant completely, firming the soil and ensuring there are no air pockets as plants are installed. When planted, cover the top of the potted soil mix with about ½-in of stormwater soil to match surrounding finished grades and help reduce wicking of moisture out of the potted soil mix. Water installed plants immediately after planting. Where specified on the Drawings, install mulch as directed.

- C. When planting on a slope, plant “out-of-the-hill” by raising the grade around the planted hole so it is flat at the surface. Do not plant “into-the-hill” by lowering the grade and do not leave the grade at an angle.

### 3.13 GROUND COVER AND HERBACEOUS PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use stormwater soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For plugs supplied in flats, plant each in a manner that minimally disturbs the root system.
  - 1. Plant plugs in holes or furrows, spaced twelve (12) inches apart in triangular pattern unless otherwise indicated on drawings. On slopes, contour furrows to near level.
- E. Work soil around roots to eliminate air pockets and maintain plant at finished grade.
- F. Water thoroughly after planting, taking care not to wet plant foliage when sunny.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.14 PLANTING AREA MULCHING

- A. Immediately after planting operations are completed, planting beds placed outside the infiltration areas and channels (areas covered in erosion control blankets) shall be covered with the specified mulch as indicated.
  - 1. For Trees and Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with a 3-foot radius around trunks or stems. Do not place mulch within three inches (3”) of trunks or stems.
  - 2. For Continuous Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within three inches (3”) of trunks or stems and off of leaves or stems for container plants and plugs.
- B. No mulch shall be placed in areas that will experience surface flows (channels, swales, etc.) or surface ponding of water (areas of basins, bumpouts, or other surface features that are designed for surface water detention). These areas that will be flooded shall only be covered with erosion control blankets and plantings or landscaping stone as specified.

### 3.15 WATERING

- A. Trees shall be watered twice within the first twenty-four (24) hours of the time of planting and not less than twice per week until provisional acceptance. Trees shall be watered at the roots, to minimize wetting of the leaves. Water shall be released slowly to prevent runoff and in sufficient

quantity to saturate the soils (approximately fifteen to twenty (15-20) gallons per watering). In the event of steady rainfall, frost, or yellowing of the leaves, watering may be temporarily reduced with the approval of Owner/Authorized Representative.

- B. Plantings must be thoroughly watered twice within the first twenty four (24) hours of the time of planting and not less than twice per week until provisional acceptance. Plants shall be watered at the roots to minimize the wetting of the leaves. Overhead watering is permitted only during overcast weather. Water shall be released slowly to prevent runoff and in sufficient quantity to saturate the soils.
- C. Suitable water for planting and maintenance will be the responsibility of the Contractor. The Contractor shall furnish his own hose and hose connections or other watering equipment.
- D. See Table of Maintenance Tasks and Schedule for further watering requirements.

### 3.16 SITE RESTORATION

- A. General
  - 1. Restore all disturbed areas to the satisfaction of Owner/Authorized Representative.
  - 2. Backfill all disturbed areas outside the Limits of Disturbance to original elevation and slope. Ensure stability of reconstructed slopes. On steep slopes, provide and arrange logs, large rocks or other devices to check erosion. Slope areas shall be seeded with the specified seed mix. The entire disturbed area of the slope shall be covered with erosion control blanket to prevent erosion. The fabric shall be pinned to the slope at 3-three foot (3') intervals.
  - 3. Restore all disturbed trenches, rubble gutters, bridle paths, asphalt paths, cinder roads, stone walls, structures, utilities, sidewalks and other fixtures in kind, to original condition, and to the satisfaction of Owner/Authorized Representative.

### 3.17 MAINTENANCE

- A. Maintenance for provisional acceptance shall begin immediately after planting is installed on a site by site basis. Contractor will begin a formalized cyclical maintenance program that will last until the end of the maintenance period of eight (8) weeks.
- B. Proposed maintenance activities and schedule shall be coordinated with the Owner/Authorized Representative and shall be in accordance with the program submitted by the Contractor based on Table of Provisional Maintenance Tasks and Schedules below.
- C. Plants shall be watered, mulched, weeded, pruned, and sprayed as described herein and otherwise maintained and protected during this period. Dead or damaged plants shall be replaced before the end of the provisional maintenance period. Maintenance activities are outlined in the table below.
- D. Submit Monthly Project Status Reports using the template in Appendix B detailing the completed maintenance activities.
- E. Site inspection for provisional approval shall take place at the end of the eight (8) week period. The Contractor shall coordinate the site inspection with the Owner/Authorized Representative ten (10) calendar days prior to the anticipated date of inspection. Should approval by the Owner/Authorized Representative be delayed until after the 8-week period has elapsed, the Contractor is responsible for continuing maintenance activities until such approval is granted.

F. Table of Provisional Maintenance Tasks and Schedules:

<b>Task</b>	<b>Description</b>	<b>Frequency</b>
Remove trash, sediment and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces and inlet gutters	Weekly
	Clean pretreatment devices; empty filter bags for inlets, domed rises or other structures. Sweep or vacuum at least five (5) ft. one either side of inlets or curb cuts.	Monthly
Remove non-target/invasive vegetation	Remove all non-target or invasive vegetation not part of the original planting manually. Weeds shall be disposed of offsite in an approved manner.	Monthly, from March to November
Water vegetation	Place and fill 15-20 gallon water bags such as Treegator® or equivalent on trees. Follow directions of manufacturer. Replace bags if they become damaged or missing.	Weekly
	Water shrubs and herbaceous plants at the base of the plant with a hose or ground-level irrigation system. Natural rainfall is not considered a watering as it will not provide the required depth of water. Each watering should slowly soak the entire depth of root system.	3 times per week on dry days; no later than 3-4 hours from dusk. Watering with an overhead system is only permitted when weather is overcast.
	Water groundcover and plugs - do not allow soil to dry out. Provide a half-inch (0.5") of water at each watering.	Daily, when there is no rainfall for first 6 weeks; twice weekly thereafter
Apply insecticides or other chemicals	Apply insecticides or other chemicals	As approved by Owner / Authorized Representative
Prune trees and shrubs	Remove dead, damaged, or diseased wood	As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through
Replace tree stakes	Replace or amend tree stakes or tree protection	As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized

		Representative Inspection and Walk-through
Apply mulch	Apply mulch to landscaped beds as needed to maintain three-inch (3") depth; extending from the edge of the bed or pit to a radius of three inches (3") from the stem of each plant. Mulch shall not touch the woody stem of a shrub or tree. When there is more than a one-inch (1") drop from the edge of the pavement to the mulch, add mulch to reduce the gap to a minimum of a half-inch (0.5") from the edge of the pavement.	As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through
Reset elevation of plants	Reset settled plants to proper grade and position	As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through
Replace dead or damaged plants	Replace plants that are more than 25% dead	As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through

END OF SECTION 329000

## SECTION 329100 - PLANTING PREPARATIONw

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SECTION INCLUDES

- A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of Planting Soils. Scope of work includes, but is not limited to, sourcing, purchase, delivery and installation of Planting Soil and soil amendments and clean up and disposal of all excess and surplus material.
- B. The specific soil types in this section include:
  - 1. Planting Soil for plant beds and lawn

#### 1.3 RELATED REQUIREMENTS

- A. Section 311000 Site Clearing
- B. Section 312000 Earthwork
- C. Section 329200 Lawn
- D. Section 329300 Plants

#### 1.4 REFERENCE STANDARDS

- A. In the event that the requirements of any of the referenced standards and specifications herein conflict with each other the more stringent requirement shall prevail. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
- B. American Society for Testing Materials (ASTM):
  - 1. ASTM C33 – Gradation Requirements for Coarse Aggregates.
  - 2. ASTM C602 Standard Specification for Agricultural Liming Materials.
  - 3. ASTM D422 – Standard Test Method for Particle Size Analysis of Soils.
  - 4. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
  - 5. ASTM D3385 – Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer.
  - 6. ASTM D4972 – Standard Test Method for pH of Soils.
  - 7. ASTM D5298 – Standard Specification for Topsoil Used for Landscaping Purposes.
  - 8. ASTM D7481 – Standard Test Methods for Determining Loose and Tapped Bulk Densities of Powders using a Graduated Cylinder.
  - 9. ASTM F1632 – Standard Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes.
  - 10. ASTM F1647 – Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes.

11. ASTM F1815 – Standard Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity, and Bulk Density of Athletic Field Rootzones.

C. Other Standards:

1. U.S. Department of Agriculture (USDA), Natural Resources Conservation Service, Soil Texture Calculator.
2. USDA, Natural Resources Conservation Service, 2003. National Soil Survey Handbook, title 430-VI, current edition.
3. USDA Soil Survey Laboratory Methods Manual, Soil Survey Investigations Report, current edition.
4. Environmental Protection Agency (EPA) Section 503 Regulations.
5. Department of Environmental Protection (DEP), Pennsylvania Bulletin, Management of Fill, Clean Fill Policy, current edition.
6. U.S. Composting Council (USCC), Test Methods for the Examination of Composting and Compost (TMECC), current edition.
7. USCC, Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost.
8. Association of Official Analytical Chemists (AOAC), Official Methods of Analysis, current edition.
9. Soil Science Society of America (SSSA), Methods of Soil Analysis, current edition.

1.5 DEFINITIONS

- A. Bulk Density: is an indicator of soil compaction calculated as the dry weight of soil by its volume typically expressed in g/cm<sup>3</sup>.
- B. Coarse Sand: sharp natural or manufactured fine aggregate and further defined in this specification.
- C. Compacted soil: soil where the density of the soil is greater than the threshold for root limiting, and further defined in this specification.
- D. Compost: Well decomposed stable organic material as defined by the US Composting Council and further defined in this specification.
- E. Planting Soil: Planting soil shall be harvested from fields or development sites or manufactured uniformly mixed individual soil components (Topsoil, Sand, Compost) or existing mineral soil at the locations of proposed planting meeting the criteria specified herein.
- F. Topsoil: Naturally produced and harvested soil from the A horizon or upper layers or the soil as further defined in this specification.
- G. Salvaged Topsoil: Topsoil stripped from the Project Site and prepared for reuse at the Project Site.

1.6 SUBMITTALS

- A. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- B. Submit dated certificates or letters, signed by the materials producer, stating that materials meet or exceed the specified requirements.
- C. For each type of manufactured product, submit data and certificates that the product meets the specification requirements, signed by the product manufacturer, and complying with testing requirements and referenced standards and specific requested testing.

- D. Laboratory soil testing requirements:
1. Samples of soil(s) to be submitted to an approved soil testing laboratory for testing in accordance with specifications herein. Submit the soil testing laboratory for review and approval prior to commencing with any soil testing.
  2. Test results shall be submitted to the Landscape Architect for approval in conjunction with soil amendment products in accordance with soil testing laboratory recommendations.
  3. Submit soil test reports including test results for each criteria listed within the Products section herein for:
    - a. Individual Components for Soil Mixes: Topsoil, Compost and Sand.
    - b. Soil Mixes Using Individual Components.
    - c. Test reports for Individual Components and Soil Mixes must be submitted concurrently.
    - d. The source of supply for Individual Components for Soil Mixes and Soil Mixes Using Individual Components must be indicated on the test report submittals.
  4. Test reports must be the same material to be supplied and must be current within the period of time defined as follows unless approved otherwise by the Landscape Architect:
    - a. Topsoil: no more than 6 months old.
    - b. Salvaged Topsoil: no more than 6 months old.
    - c. Compost: no more than 3 months old.
    - d. Sand: no more than 6 months old.
    - e. Planting Soil: test data must be no more than 1 month old.
    - f. Sample test results shall be considered valid until the time of construction and for the material supplied.
  5. If tests fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by the Landscape Architect.
  6. Soils shall not contain any traces of hydrocarbons, petroleum products, chemically prohibited substances, or any other elements considered to be toxic to any vegetation that is used. Clean fill certification shall be submitted by the manufacturer.
  7. All soil testing will be at the expense of the Contractor.
- E. Physical samples:
1. All samples must be submitted simultaneously with the laboratory test reports. Samples are required for the following:
    - a. Salvaged Topsoil
    - b. Manufactured Planting Soil
  2. Provide one (1) one-gallon sample in a resealable plastic bag to the Landscape Architect.
- 1.7 On-site verification soil testing requirements:
- A. Landscape Architect may require Compaction Testing:
1. Maintain an up-to-date written report of compaction test results. Test compaction every 12-inch lift of soil for every 300 square feet of soil installed for each planting area designated on the Drawings. The Landscape Architect may review the written report at any time to confirm conformance with the specification. Submit final report at the completion of soil installation.
  2. Maintain at the site at all times a soil cone penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
    - a. Penetrometer shall be AgraTronix Soil Compaction Meter or approved equal.
    - b. Moisture meter shall be "general digital soil moisture meter".
- B. Should any verification test results indicate soil material is not consistent with the approved submittals or requirements specified herein, the Contractor shall remove the installed soil and re-install soil at the Contractors expense until the Contract Document requirements are met.
- 1.8 Accompany each delivery of soil mixes, bulk materials, fertilizers and soil amendments provide the appropriate certificates and delivery tickets to the Landscape Architect. The soil supplier must be



indicated on delivery tickets for all soil mix deliveries and the supplier must match the approved submittals.

1.9 Quality Assurance

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, PADEP Clean Fill Guidance, unless otherwise specified.
- B. Soil Testing Laboratory Qualifications: The laboratory shall be an independent laboratory, recognized by the State Department of Agriculture. The testing laboratory must have experience in performing agronomic testing including physical and chemical properties of soil. Tests shall be made in strict compliance with the standards of the Association of Official Analytical Chemists and follow standards from the NRCS Soils Manual and ASTM testing methods applicable to the specific tests requested. Laboratory shall have staff fully qualified to review test results, and to make recommendations to amend samples based on what is planned to grow in the soil. American Association for Laboratory Accreditation (A2LA) certification is preferred.
  - 1. Compost that participates in the US Composting Council's Seal of Testing Assurance (STA) Program and tested through an STA program lab, using appropriate test methods from the TMECC (Test Methods for the Examination of Compost and Composting) is preferred. Test data shall be presented on a Compost Technical Data Sheet.
- C. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the Landscape Architect and the University.
- D. Installer Qualifications: The installer shall be a firm having at least five (5) years of experience of a scope similar to that required for the work.
  - 1. Installer Field Supervision: When any soil work is in progress, installer shall maintain, on-site, an experienced full-time supervisor.
  - 2. Installer's field supervisor shall have a minimum of five (5) years experience as a field supervisor installing soil, shall be trained and proficient in the use of field surveying equipment to establish grades.

1.10 Delivery, Storage, and Handling

- A. Preparation, amendment, and mixing of soils shall be performed at the soil supplier location.
- B. Weather: Do not mix, deliver, place or grade soils when frozen or with moisture above field capacity. Soils shall not be handled, hauled, placed, or compacted when wet or frozen. Soil shall only be handled when the moisture content is between the specified ranges in percent water by volume.
- C. Protect soil and soil stockpiles, including the stockpiles at the soil blender's yard, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by chemicals, dust and debris that may be detrimental to plants or soil drainage. Once spread, soils shall be protected with staked erosion control blankets.
- D. All manufactured packaged products and material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. Biological additives shall be protected from extreme cold and heat. All products shall be freshly manufactured and dated for the year in which the products are to be used.
- E. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

- F. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- G. None of the soil materials shall be delivered to the site until sample certifications are approved by the Landscape Architect, however, such approval does not constitute final acceptance. Certification submittal shall include recommended soil amendment products if proposed to modify the soils. Any approval of soils made conditional upon utilizing one or more amendments shall be understood to afford to the Landscape Architect the right for further testing and refusal of materials that do not meet these Specifications.

## PART 2 - PRODUCTS

### 2.1 Individual Components for Soil Mixes

#### A. Topsoil

- 1. Topsoil definition: Topsoil shall be a harvested from the Project Site or fields or development sites and shall be loose, friable mineral particles resulting from natural soil formation from the A, E and upper B horizons, or "solum" where most plant roots grow. Manufactured soils where sand, composted organic material, chemical additives or similar elements has been blended to meet the requirements of Topsoil is not acceptable. The soil shall be free of construction and trash debris, rocks, hydrocarbons, petroleum materials, herbicides, or other harmful contaminants that would impact plant growth.
  - a. Topsoil shall comply with the following parameters:
    - i) Organic matter (ASTM F1647, Method A): 1.5% minimum (by dry weight).
    - ii) pH (1 soil : 1 water): 5.0 - 7.0.
  - b. Stockpiled Existing Topsoil at the site meeting the above criteria may be acceptable.

#### B. Organic Amendment / Compost

- 1. Compost is as defined by the "US Composting Council Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost". Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; leaf litter and yard trimmings; or source-separated waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.
- 2. Compost shall comply with the following parameters:
  - a. pH: 6.0 - 8.0.
  - b. Soluble salt content (electrical conductivity, 1 soil : 2 water): maximum 5 dS/m (mmhos/cm).
  - c. Compost derived from stabilized mushroom soil compost may possess a maximum EC of 10 dS/m (1:2), if the maturity testing is a minimum of 95% and ammonia (NH<sub>4</sub>) content is a maximum of 250 ppm.
  - d. Moisture content %, wet weight basis: 30 – 60.
  - e. Organic Matter Content, % dry weight basis: 30 – 65.
  - f. Particle size, dry weight basis: 98% pass through 1/2 inch screen.
  - g. Stability carbon dioxide evolution rate: mg CO<sub>2</sub>-C/ g OM/ day ≤ 3.
  - h. Maturity, seed emergence and seedling vigor, % relative to positive control: minimum 80%.
  - i. Physical contaminants (inerts), %, dry weight basis: <0.5%.
  - j. Chemical contaminants, mg/kg (ppm): meet or exceed US EPA Class A standard, 40CFR § 503.13, Tables 3 levels.
  - k. Biological contaminants select pathogens fecal coliform bacteria, or salmonella, meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) level requirements.

C. Coarse Sand

1. Sharp natural or manufactured fine aggregate shall be hard and durable and free of limestone (calcareous sand), shale and slate particles and free of harmful contaminants that would impact plant growth complying with the following parameters:

- a. pH shall be lower than 7.0.

- b. Sieve analysis:

Sieve	Percent passing (by mass)
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3/8 inch (9.5 mm)	100
No 4 (4.75 mm)	95-100
No 8 (2.36 mm)	80-100
No 16 (1.18 mm)	50-85
No 30 (.60 mm)	25-75
No 50 (.30 mm)	5-40
No 100 (.15 mm)	2-20
No 200 (0.75 mm)	2-15

- c. Particle analysis must be per USDA classification, Sand.

Sand (2 - 0.05 mm): ≥88%

Silt (0.05 - 0.002 mm): ≤9%

Clay (< 0.002 mm): ≤3%

D. Chemical Amendments

1. Lime, ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
  - a. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
  - b. Provide lime in form of dolomitic limestone.

2.2 Soil Mixes Using Individual Components

A. Definition

1. Manufactured uniformly mixed individual soil components (Salvaged Topsoil, Topsoil, Sand, Compost) meeting the criteria specified herein. Provide Soils at the locations indicated on the Drawings complying with the following parameters.

B. Planting Soil, Plant Beds and Lawn

1. Planting soil shall be manufactured from uniformly mixed individual soil components (Salvaged Topsoil, Sand, Compost) or existing mineral soil at the locations of proposed planting meeting the criteria specified herein.
2. Provide Planting Soil at the locations indicated on the Drawings complying with the following parameters:
  - a. Particle analysis must be per USDA classification for loam, sandy loam, sandy clay loam, or silt loam within the following parameters using ASTM D422:

Sand: 45 - 55%

Silt: no more than 30%

Clay: no more than 20%

Gravel content larger than 2mm shall be less than 12%.
  - b. pH (1 soil : 1 water): 6.0 - 7.2.
  - c. Organic matter (ASTM F1647, Method A): 3 - 6% (by dry weight).
  - d. Hydraulic conductivity (ASTM F1815) at 85% Proctor (ASTM D698): 1.0 in/hr +/- 0.5 in/hr
  - e. Soluble salt content (electrical conductivity, 1 soil : 2 water): maximum 1.60 mmho/cm. Sodium (Na) salinity shall not exceed 700 ppm.

- f. Cation Exchange Capacity (CEC): >15 meq/100g.
  - g. Nutrient analysis including macronutrients and micronutrients (Mehlich-3) with soil fertility interpretation and recommendations relevant to the specified plant species.
  - h. Compost shall not be added at more than 30% by volume.
- C. Erosion Control Mat
- 1. Straw Blanket
    - a. For use on 4:1 to 3:1 slopes with moderate runoff conditions: utilize ECS-1 Single Net Straw Rolled Erosion Control Blanket, East Coast Erosion Blankets, 443 Bricker Road, Bernville, PA 19506, 800-582-4005, [www.erosionblankets.com](http://www.erosionblankets.com), or approved equal.
    - b. Matting containing non-degradable plastic mesh is prohibited.
  - 2. Straw Mulch:
    - a. For use on slopes less than or equal 4:1 with minimal runoff conditions: utilize mildew-free and seed-free salt hay with a nonasphaltic liquid tackifier.
- D. Amendments
- 1. At the time of final grading, add fertilizer if required to the Planting Soil at rates recommended by the testing results for the species of plants to be grown.

### PART 3 - EXECUTION

#### 3.1 SITE EXAMINATION

- A. Prior to installation of soil, examine site to confirm that existing conditions are satisfactory for the work of this section to proceed. The Landscape Architect shall approve the condition of the subgrade and the previously installed subgrade preparation and the installation of subsurface drainage.
- 1. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope toward the under drain lines as shown on the Drawings.
    - a. Subgrade definition: surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing Planting Soil.
  - 2. Confirm that all surface areas to be filled with Soil are free of construction debris, refuse, compressible or biodegradable materials, stones greater than 2 inches diameter, soil crusting films of silt or clay that reduces or stops drainage from the Soil into the subsoil; and/or standing water. Remove unsuitable material from the site.
    - a. Debris definition: Elements including, but not limited to, concrete, concrete masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse and litter.
  - 3. Confirm that no adverse drainage conditions are present.
  - 4. Confirm that no conditions are present which are detrimental to plant growth.
- B. If unsatisfactory conditions are encountered, notify the Landscape Architect immediately to determine corrective action before proceeding.

#### 3.2 SOIL INSTALLATION

- A. All equipment utilized to install or grade Soils shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less. All grading and soil delivery equipment shall have buckets equipped with 6 inch long teeth to scarify any soil that becomes compacted.
- B. In areas of soil installation above existing subsoil, scarify the subgrade material prior to installing Soil.

1. Scarify the subsoil of the subgrade to a depth of 3 – 6 inches with the teeth of the back hoe or loader bucket, tiller or other suitable device.
  2. Immediately install the Planting Soil. Protect the loosened area from traffic. DO NOT allow the loosened subgrade to become compacted.
  3. In the event that the loosened area becomes overly compacted, loosen the area again prior to installing the Planting Soil.
- C. Install the Planting Soil in 6 inch lifts to the required depths. Minimum depth of planting soil in plant beds is 24 inches or as shown on the Drawings.
1. Apply compacting forces to each lift as required to attain the required compaction. Scarify the top of each lift prior to adding more Planting Soil by dragging the teeth of a loader bucket or backhoe across the soil surface to roughen the surface.
  2. Approved compaction equipment includes a smooth drum roller or plate compactor. Typically one to three passes per lift will achieve the desired compaction. Contractor to test desired compaction methodology with actual soil to be installed to confirm installation method and material properties are compatible and will achieve the specified compaction rates.
  3. Provide adequate equipment to achieve consistent and uniform compaction of the Soils. Use the smallest equipment that can reasonably perform the task of spreading and compaction. Use the same equipment and methods of compaction for the entire project area once soil, installation methodology, and compaction criteria have been coordinated and confirmed.
- D. Do not pass motorized equipment over previously installed and compacted soil except as authorized below.
1. Light weight equipment such as trenching machines or motorized wheel barrows is permitted to pass over finished soil work.
  2. If work after the installation and compaction of soil compacts the soil to levels greater than the above requirements, follow the requirements of Over Compaction Reduction herein.
- E. Phase work such that equipment to deliver or grade soil does not have to operate over previously installed Planting Soil. Work in rows of lifts the width of the extension of the bucket on the loader. Install all lifts in one row before proceeding to the next. Work out from the furthest part of each bed from the soil delivery point to the edge of each bed area.
- F. Where travel over installed soil is unavoidable, limit paths of traffic to reduce the impact of compaction in Planting Soil. Each time equipment passes over the installed soil it shall reverse out of the area along the same path with the teeth of the bucket dropped to scarify the soil. Comply with Over Compaction Reduction herein in the event that soil becomes over compacted. Access over finished grade soils shall be restricted. If access is required across placed soils, Contractor shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils as directed by the Landscape Architect.
- G. The depths and grades shown on the Drawings are the final grades after settlement and shrinkage of the compost material. The Contractor shall install the Planting Soil at a higher level to anticipate this reduction of Soil volume. A minimum settlement of approximately 10 - 15% of the soil depth is expected. All grade increases are assumed to be as measured prior to addition of surface Compost till layer, or mulch.
- H. Maintain moisture conditions within the Soil during installation or modification to allow for satisfactory compaction.
1. Volumetric soil moisture level during installation shall be above permanent wilt point and below field capacity for each type of soil texture within the following ranges.

Soil texture	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

2. The Contractor shall confirm the soil moisture levels with a moisture meter (Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent). Suspend operations if the Soil becomes wet. Apply water if the soil is overly dry.

I. Installing Planting Soil with soil or mulch blowers or soil slingers is not permitted.

### 3.3 SOIL COMPACTION REQUIREMENTS FOR PLANT BEDS AND LAWN

A. The following are threshold levels of compaction as determined by each method for the subsoil surface and full profile of Planting Soil, testing each lift of Soil with a penetrometer. The same penetrometer and moisture meter shall be used to test installed soil throughout the work.

1. Acceptable Compaction
  - a. Standard Proctor Method – 75-85%.
  - b. Penetration Resistance Method – about 75-250 psi.
  - c. Soil below 75 psi soil becomes increasingly unstable and will settle excessively.
2. Unacceptable Compaction
  - a. Standard Proctor Method – Above 85%.
  - b. Penetration Resistance Method – Approximately above 300 psi
3. Prior to testing the soil with the penetrometer check the soil moisture. Penetrometer readings are impacted by soil moisture and excessively wet or dry soils will read significantly lower or higher than soils at optimum moisture.
4. The penetrometer readings shall be within 20% plus or minus of the specified levels.
5. Where the Standard Proctor Method is utilized, the following Bulk Density levels based on 75% minimum and 85% maximum standard Proctor indicate acceptable compaction.

Soil Texture	Bulk Density (g/cm <sup>3</sup> )	
	Max.	Min.
Loamy Sand	1.80	1.65
Sandy Loam	1.65	1.45
Sandy Clay Loam	1.55	1.35
Loam	1.50	1.30
Silt Loam	1.45	1.25

### 3.4 OVER COMPACTION REDUCTION

- A. Compacted soil: soil where the density of the soil, at each lift for the full profile, is greater than the threshold for root limiting, and further defined in this specification.
- B. Any soil that becomes compacted to a density greater than the specified density shall be dug up and reinstalled. This requirement includes compaction caused by other sub-contractors after the Planting Soil is installed and approved.
- C. Surface roto tilling shall not be considered adequate to reduce over compaction at levels 6 inches or greater below finished grade.

### 3.5 INSTALLATION OF CHEMICAL ADDITIVES

- A. Following the installation of each soil and prior to fine grading and installation of the Compost till layer, apply chemical additives as recommended by the soil test, and appropriate to the soil and specific plants to be installed.
- B. Types, application rates and methods of application shall be approved by the Landscape Architect prior to any applications.

### 3.6 FINE GRADING

- A. Fine grading: The final grading of the soil to achieve exact contours and positive drainage, often accomplished by hand rakes or drag rakes other suitable devices, and further defined in this specification, and further defined in this specification.
- B. The Landscape Architect shall approve all rough grading prior to the installation of Compost, fine grading
- C. Grade the finish surface of all planted areas to meet the grades shown on the Drawings, allowing the finished grades to remain higher than the grades on the grading plan, as defined in paragraph Soil Installation, to anticipate settlement over the first year.
- D. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use the flat bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.
- E. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the Landscape Architect in the event that conditions make it impossible to achieve positive drainage.
- F. Provide smooth, rounded transitions between slopes of different gradients and direction. Modify the grade so that the finish grade before adding mulch and after settlement is one or two inches below all paving surfaces or as directed by the Drawings.

### 3.7 INSTALLATION OF IN-SITU COMPOST AMENDMENT

- A. After Planting Soil is installed in planting bed areas, spread 2 – 3 inches of Compost over the beds and roto till into the top 4 - 6 inches of the Planting Soil. This step will raise grades slightly above the grades required in Fine Grading herein. This specification anticipates that the raise in grade due to this tilling will settle within a few months after installation as Compost breaks down. Additional settlement as defined in paragraph "Soil Installation" must still be accounted for in the setting of final grades.
- B. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, (or spade tiller), and further defined in this specification.

### 3.8 PROTECTION

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.

3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

- B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by the Landscape Architect and replace contaminated planting soil with new planting soil.

### 3.9 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329100W



## SECTION 329200 - LAWN AND FINE GRADING

### 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. Sodding of lawns.
  - 2. Seeding of lawns disturbed during construction.
  - 3. Maintenance of lawn areas until acceptance.
- B. Related Sections:
  - 1. Division 2 Section "Planting".
  - 2. Division 2 Section "Soil Preparation".

#### 1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. 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.
- C. 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.
- D. Topsoil: Native or Imported topsoil. See Soil Preparation section.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

#### 1.4 SUBMITTALS

- A. Submit prior to delivery of materials to site.
  - 1. Submit seed mixes for review.
- B. Certifications: Submit certificate with names of materials and manufacturer.
  - 1. Ground limestone: Include guaranteed analysis, and weight for packaged material.

2. Commercial fertilizers: Include guaranteed analysis.
3. Seed: include origin of seed.
- C. Product data: Submit product literature or tear sheets with name of product, and manufacturer.
  1. Commercial fertilizer, including type and application rate.
- D. Source of supply: Submit in writing all proposed sources.
- E. Test reports: Submit test reports at least three (3) weeks prior to delivery of materials to site.
  1. Seed: Test for purity, proportion by weight, weed seed content and germination percentage of all seed mixture proposed for use. No seed shall be delivered until the test reports are approved. All seed shall be tested within six (6) months immediately preceding date of sowing. Seed must comply with all Commonwealth of Pennsylvania seed certifications.
- A. Qualification Data: For qualified landscape Installer.
- B. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
  1. Experience: Five (5) years' experience in turf installation in projects of similar complexity in addition to requirements in Division 1 Section "Quality Requirements."
  2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  3. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
  4. Pesticide Applicator: State licensed, commercial.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaged materials: Deliver packaged materials in clearly marked containers showing net weight, guaranteed analysis and name of manufacturer. Specified requirements for packaged materials apply to bulk shipments. Protect materials from deterioration during delivery and during storage at site.
  1. Deliver fertilizer and limestone in waterproof bags.
  2. All seed shall be labeled to show compliance with requirements of governmental agencies having jurisdiction. All bag tags of seed used shall be retained and if requested, submitted to Owner. Seed shall be kept in dry storage away from contaminants, insects and rodents.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

1.7 PROJECT CONDITIONS

A. Protection of existing conditions adjacent to and within construction zone:

1. All necessary precautions for safety including barricades and other protection measures shall be taken during all work.
2. All heavy equipment shall be driven or parked on the site only where approved by Owner.
3. Existing pavements, lawns, structures, walls, etc. damaged or disturbed during construction shall be repaired or replaced to the satisfaction of the Owner.
4. Repair and replace all active utility lines, above and below grade, damaged in the course of construction operations.
5. Avoid damaging existing trees. Damage includes but is not limited to: cutting, breaking, skinning or compacting of roots, skinning and bruising of bark and breaking of branches and limbs.
  - a. Contractor shall not park or store equipment and supplies within four (4) feet of trunk of existing trees to remain.

B. Environmental requirements:

1. Seed only between April 1 - June 15 and September 1 - October 15, unless otherwise permitted by the Owner.
2. Do not seed during adverse weather, windy conditions or on wet or frozen ground.

1.8 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Sodded Turf: 30 days from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

- A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Proportioned by weight as follows: 90% Turf-type Tall Fescue comprised of at least three varieties and 10% Kentucky Bluegrass.

## 2.2 SEED

- A. Fresh, clean, new seed. Seed shall be packed in sealed 50 lb. bags showing net weight, composition of mix, date of germination tests and supplier's name. Germination test must be done within a nine-month period prior to sale of the seed.
  1. Seed shall not contain in excess of 0.1% by weight weed seed, no more than 1.5% inert matter, and no more than 0.1% other crop seed and no noxious weed seed or undesirable grass species. Comply with state laws governing noxious weeds. Seed containing prohibited or restricted noxious weeds shall not be accepted.
  2. Seed shall be Pennsylvania certified and blue tagged.
- B. Composition of the mix shall be a turf-type tall fescue blend of 60% of at least three (3) varieties of turf-type tall fescue, 30% of Perennial Rye Grass, and no more than 10% Kentucky Bluegrass.

## 2.3 LIMESTONE

- A. In accordance with soil test recommendations, provide ground, high magnesium limestone containing not less than 85% total carbonates, 95% passing a 20 mesh sieve, 40% passing a 60 mesh sieve and a minimum of 30% percent passing a 100 mesh sieve.

## 2.4 MULCH

- A. Mulch shall consist of specially prepared wood cellulose processed into a uniform fibrous physical state. Wood cellulose fiber mulch shall be dyed green or contain a green dye in the package that will provide an appropriate color to facilitate visual inspection of the uniformly spread slurry. The fiber mulch, including dye, shall contain no germination or growth inhibiting factors. The mulch material shall be manufactured and processed in such a manner that the wood cellulose fiber mulch will remain in uniform suspension in water under agitation and will blend with other additives to form a homogenous slurry. The mulch material shall form a blotter-like ground cover, on application, having moisture absorption and percolation properties and shall cover and hold grass seed in contact with the soil without inhibiting the growth of the grass seedlings.
- B. Mulch shall contain no elements or compounds at concentration levels that will be phytotoxic. Wood cellulose fiber must conform to the following physical requirements:
  1. fiber length to be approximately 10 mm
  2. diameter approximately 1 mm
  3. pH range of 4.0 to 8.5
  4. ash content of 1.6% maximum
  5. water holding capacity of 90% minimum
- C. Slope stabilization: in areas where erosion may occur, use an organic tackifier such as CONTACT or an erosion fabric or approved equal, in accordance with manufacturer's instructions.

## 2.5 WATER

- A. Potable, clean fresh and free from harmful materials. Contractor shall provide all means of conveyance including hoses, sprinklers, tank trucks or other means which may be required to water lawns until accepted by Owner.

## 2.6 FERTILIZER

- A. A standard complete slow release fertilizer. At least 50% by weight of the nitrogen content of the fertilizer shall be derived from organic materials with the remainder in urea form or equivalent. Fertilizer shall contain percent nitrogen, phosphorous, and potash by weight of ingredients dictated by the topsoil test results.

1. Fertilizer shall be in bags showing weight, analysis, and manufacturer's name

## 2.7 PESTICIDES

- C. 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.
- D. Pre-Emergent and Post-Emergent Herbicides (Selective and Non-Selective) shall only be used with written authorization by the Owner.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
  1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  2. Do not work soil in frozen, wet, or muddy conditions.
  3. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner and replace with new planting soil as specified in Division 2 Section "Soil Preparation".

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.3 TURF AREA PREPARATION

- A. Grass seed shall be applied to all disturbed areas a result of this project.
- B. Preparation of surface for seeded areas (except within root zones of existing trees):
  1. Vertically aerate soil if it has become compacted as a result of construction activities.
  2. Prior to applying soil amenities, roll lawn area with a filled water roller. Correct any surface irregularities to prevent formation of low spots.
  3. If required by soil test, evenly distribute ground limestone at the recommended rate. Work lightly into the top four (4) inches of topsoil at least one full week prior to applying fertilizer.

4. Spread starter fertilizer uniformly, at the rate determined by soil test for new lawns. Add organic matter 1" deep, if required by soil test.
5. Go over the entire area with a spike drag or rototiller and loosen surface at least 3" deep and then hand rake to a smooth, even surface.

### 3.4 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  1. Lay sod across angle of slopes exceeding 1:3.
  2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

### 3.5 SEEDING

- A. As soon as ground has been properly prepared, sow grass seed at the rate of 6 lbs. per 1,000 sq. ft. total. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
  1. Use suitable mechanical seeder to sow by hand for small areas.
- B. Cover seed with a thin layer of topsoil by light raking.
- C. Roll seed in both directions very lightly with an empty water roller.
- D. After seed application, apply mulch at a net dry weight of 1,500 lbs. per acre. Mulch shall be mixed with water and the mixture shall contain a maximum of 50 lbs. of wood cellulose fiber per 100 gallons of water. Use a slope stabilizing device in areas where erosion may occur.
- E. Water with a fine spray immediately after seeding operations are completed.
  1. Water all newly installed seeded areas as necessary to keep lawn healthy. Apply water in sufficient quantities so it penetrates four (4) inches into planting soil without puddling. Continue watering until seeded areas are accepted by the Owner.
- F. Protect all newly seeded lawn areas from damage.
- G. When seeding occurs after acceptable seeding dates, over winter protection shall consist of applying five bales clean straw per 1,000 sq. ft. and anchor mulch by commercial mulch netting or 20 lbs./1,000 sq. ft. cellulose fiber. Asphalt emulsion anchoring is not permitted.

### 3.6 TURF MAINTENANCE

- A. Begin maintenance immediately after each lawn area is restored.
  1. All lawn areas shall be watered and kept moist to maximize germination.
    - a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.

- b. Seed: Water seeded areas as often as required to keep the top 1-inch of soil moist until the seed germinates. Avoid excessive water that will cause the seeds to rot. Once seedlings have germinated and established reduce watering frequency and increase volume for deeper watering. Continually adjust irrigation system until intervals have been stretched to the greatest extent practical.
2. All areas and spots which do not show a prompt catch of grass shall be reseeded and this operation repeated until complete coverage is obtained.
3. When the area does not need to be reseeded, it shall be thoroughly wetted every time the surface shows evidence of drying out and this shall continue through entire period of maintenance.
4. When the average height is 3-4" and the lawn areas are fully germinated, firmly rooted and secure in place, grass shall be cut to 2-3" or 1/3 of the grass blade. Any depressions or irregularities in the lawn surface shall be leveled off and reseeded.
5. Maintenance shall cease after the third mowing, provided all grass areas are properly established and free of washouts, depressions, bare spots, weeds and large off-color areas. If seeding is done in the autumn, the Contractor shall complete the three mowings in the following spring.
6. All lawns shall show a uniform, thick, well-developed stand of grass. If the grass stand is unsatisfactory, the Contractor's maintenance responsibility shall continue until an acceptable stand of grass is achieved.

### 3.5 SATISFACTORY LAWN

- A. Seed installations shall meet the following criteria as determined by Owner:
  1. Satisfactory Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
  2. Provide at minimum three (3) mowings in accordance with grass height requirements.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

### 3.6 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of 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. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.
- C. Notification signage must be posted at every entrance in a highly visible location at least five (5) days in advance of application and maintained five (5) business days following application, or as recommended by the manufacturer's instructions, whereby it is then removed from the site.
  1. Notification Signage shall be brightly colored, laminated and at least 8.5" by 11" format including the following information:
    - a. Date of Notification.
    - b. Date of Application.

- c. Name of Chemical.
- d. Reason for Chemical Application.
- e. Information informing as to the precautions that must be taken including humans and pets.

### 3.7 CLEANUP AND PROTECTION

- A. Do not allow soil and debris created by turf work onto permeable unit paving areas. Promptly clean up any soil or debris on impervious paving areas, such as concrete sidewalk or roadway paving. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Protection of newly planted lawn areas is critical to healthy establishment. Erect temporary protection fencing and warning signs to protect newly planted areas from traffic. Maintain fencing throughout initial maintenance period. Remove protection fencing only after lawn areas have become well established and are able to tolerate regular use. Install temporary protection fencing and signage in accordance with the following:
  - 1. Temporary Protection Fencing
    - a. Fencing shall cordon off the entire perimeter of lawn area to prevent access.
    - b. Fencing shall be supported securely as required to remain erect for duration of site protection. Utilize heavy-duty 12 gauge minimum metal fence posts spaced at 6 to 8 feet on center, or as required. Posts shall be driven into the soil sufficient depth to support fencing against heavy wind load.
    - c. Fencing shall be at least 4-foot high. Secure fencing to posts at the top and bottom and in at least one location in the middle with zip or cable ties. Fencing may also be woven through each post and secured at the top only with a zip tie.
  - 2. Signage: Notification signage shall be brightly colored, laminated and at least 8.5" by 11" format attached to fencing every 10 to 12 feet, including the following information.
    - a. "Please keep off lawn areas. Lawn will be available once protection fencing has been removed."
- C. If utilized, remove non-degradable erosion-control measures after grass establishment period.

END OF SECTION 329200



## SECTION 329300 - PLANTS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Provide trees and groundcover and all necessary accessories.
  - 2. Maintenance and replacement during Establishment Period.

#### 1.2 RELATED SECTIONS

- A. Section 329100 – Planting Preparation
- B. Section 329200 – Lawns and Fine Grading

#### 1.3 REFERENCES

- A. The following apply to work in this Section:
  - 1. ASNS: “American Standard for Nursery Stock,” latest edition, published by the American Nursery and Landscape Association.
  - 2. NAA: “National Arborist Association Standards for Pruning”, latest edition, published by the National Arborist Association.
  - 3. ANSI: “American National Standards Institute”, latest edition.

#### 1.4 SUBMITTALS

- A. Certifications: Submit certificate with names of materials and manufacturer.
  - 1. Plants: Furnish certificates of inspection as may be required by Federal, State or other authorities that plants are free of disease or hazardous insects.
  - 2. Commercial fertilizers: Include guaranteed analysis.
  - 3. Ground limestone: include guaranteed analysis and weight for packaged material.
  - 4. Commercial fertilizers: include guaranteed analysis.
- B. Instructions: Submit planting and maintenance schedule.
  - 1. Submit the proposed planting installation schedule indicating dates for tagging and installation, dates and duration of plant storage at an off-site location, and a detailed program of Establishment Period maintenance.
- C. Product data: Submit product literature or tear sheets with name of product, and manufacturer.
  - 1. Commercial fertilizer.
  - 2. Mulch.
- E. Samples: Submit loose materials in sealed bags labeled with name of material and manufacturer.
  - 1. Mulch, 1/2 lb. bag.
- F. Source of supply: Submit in writing all proposed sources.
  - 1. Locate trees and make all pre-selection arrangements at the source of supply required to ensure an efficient selection procedure. Landscape Architect, with Contractor present, will select plants at nursery on the basis of their compliance with the Drawings. Contractor shall

inspect the selected plants on the basis that the plants are free of disease and otherwise conform to the requirements of the Contract Documents. The accuracy of the varieties of species specified for plant material shall be the Contractor's responsibility. Request visit at least 14 days in advance of desired inspection date.

- a. Trees will be inspected and approval given by Landscape Architect at the source for conformity to Specification requirements. Such approval shall not affect the right of inspection and rejection during delivery and installation.
- b. All trees specified as B&B must be in the ground at the growing source at the time of inspection. Pre-dug trees shall not be acceptable.

#### 1.5 QUALITY ASSURANCE

- A. Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with planting installation and general construction techniques under the supervision of an experienced landscape foreperson.
- B. Plants: Meet or exceed applicable AAN standards.
  1. Plant List: Investigate sources of supply prior to submitting bid. Confirm that size, variety and quantity of plants specified on Plant List can be supplied. Failure to take this precaution shall not relieve the successful bidder from responsibility for furnishing and installing all plants in strict accordance with Contract requirements.
    - a. Substitutions shall not be permitted unless substantiated written proof is supplied that a specified plant is not obtainable. In this situation a proposal to use the nearest equivalent size or variety with an equitable adjustment of Contract Price will be considered.
    - b. Plant substitutions will be permitted only upon approval by the Owner and Landscape Architect.
    - c. All plants shall be grown on their own roots. No grafted species shall be acceptable.
    - d. Plants shall be of the quantity and quality indicated, true to name, properly labeled with botanical name and in accordance with the sizes and grades specified.

#### 1.6 PROJECT CONDITIONS

- A. Protection of existing conditions adjacent to and within construction zone:
  1. All necessary precautions for safety including barricades and other protection measures shall be taken during all work.
  2. All heavy equipment shall be driven or parked on the site only where approved by Owner.
  3. Existing pavements, structures, walls, etc. damaged or disturbed during construction shall be repaired or replaced to the satisfaction of the Owner.
  4. Repair and replace all active utility lines, above and below grade, damaged in the course of construction operations.
  5. Avoid damaging existing trees. Damage includes but is not limited to: cutting, breaking, skinning or compacting of roots, skinning and bruising of bark and breaking of branches and limbs.
    - a. Contractor shall not park or store equipment and supplies within four (4) feet of trunk of existing trees to remain.
- B. Environmental requirements:
  1. Plant only within the following dates, weather permitting. Do not plant when ground is frozen, when the soil is excessively wet, when ambient air temperature exceeds 85 degrees or in otherwise unsatisfactory weather conditions.
    - a. Plant between March 1 and June 15 and August 15 until the ground freezes.
    - b. Plant trees known to be fall digging hazards only in the Spring.
  2. Chemical Spraying Program: no spraying of herbicides, insecticides, fungicides, nematicides, fumigants or other chemicals shall be done without first submitting a spray program to the Owner.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Packaged materials: Deliver packaged materials in clearly marked containers showing net weight, guaranteed analysis and name of manufacturer. Specified requirements for packaged materials apply to bulk shipments. Protect materials from deterioration during delivery and during storage at site.
  - 1. Deliver fertilizer in waterproof bags.
  - 2. All seed shall be labeled to show compliance with requirements of governmental agencies having jurisdiction. All bag tags of seed used shall be retained and if requested, submitted to Owner. Seed shall be kept in dry storage away from contaminants, insects and rodents.
  
- B. Plants: Notify Owner seven (7) days in advance of any delivery of plants to site.
  - 1. Dig and handle trees with care to prevent injury to trunks, branches and roots. Do not prune prior to delivery. Do not bend or bind-tie trees in such manner as to damage bark, break branches or destroy natural shape. Pack and ship to ensure arrival at site in good condition. Provide protective covering during delivery. Plants with cracked or broken root balls shall not be accepted.
  - 2. Deliver plants after preparation of planting areas has been completed and approved, install plants immediately.
    - a. If planting is delayed more than eight (8) hours after delivery, set balled and burlapped plants on the ground well protected with soil, wet mulch or other acceptable material. Protect balls and roots, and container grown material from freezing, sun, drying winds and/or mechanical damage. Water as necessary until planted.
    - b. Do not heel in plants for more than five business days.
  - 3. Immediately remove rejected plants from site.

## 1.8 INSPECTION FOR SUBSTANTIAL COMPLETION

- A. Plants:
  - 1. All plants shall be alive, healthy and installed to be accepted.
  - 2. Guarantee Period for plants shall not begin until all items have been completed or corrected.

## 1.9 GUARANTEE / ESTABLISHMENT PERIOD FOR PLANTS

- A. Contractor shall not be held responsible for acts of vandalism occurring after the beginning of Guarantee Period, nor shall Contractor be held responsible for deleterious effects caused by maintenance procedures performed by Owner without concurrence of Contractor.
  
- B. Replace at no additional cost for a period of two growing seasons after the beginning date of Guarantee Period, any plants that have died or that are, in the opinion of Owner, in unhealthy or unsightly condition, or that have lost their natural shape due to dead branches, excessive pruning, excessive defoliation.
  - 1. A growing season is defined as the period during which plant growth takes place from last killing frost of Spring to the first killing frost of Autumn.
  - 2. Replace unacceptable plants no later than the next succeeding planting season. All replacements shall have a guarantee of one planting season from date of replacement.
    - a. Replace unacceptable plants in accordance with original Specification. Cost is considered to be included in the Bid and Contract Price.

## PART 2 PRODUCTS

### 2.1 PLANTS

- A. Provide freshly dug plants nursery grown in accordance with good horticultural practice.

1. Sound, healthy and vigorous, well-branched and fully foliated when in leaf, free from disease, insect pests, eggs or larvae with healthy well-developed root systems.
  - B Conform to measurements specified on Plant List. Plants shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at time of planting. Requirements for the measurement, branching, grading, quality, balling, and burlapping of plants shall be in accordance with standards specified in ASNS and conform to ANSI Z.60.1.
  - C. Provide B&B stock with a compact natural ball of earth, firmly wrapped and tied in burlap so that upon delivery the soil in the ball is still firm and compact about the small feeding roots. Root ball sizes shall be in accordance with standards specified in ASNS.
  - D. Furnish trees with rootballs measured from top of rootball which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before trees are dug to ensure proper rootball depth.
  - E. Plants shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at time of planting. Requirements for the measurement, branching, grading, quality, balling, and burlapping of plants shall be in accordance with standards specified in ASNS.
- 2.2 STAKING AND GUYING MATERIALS
- A. Tree Stakes: 2" x 2" x 8' long wood posts, minimum 2 per tree, if required.
  - B. Guys: Nylon straps shall be used wrapped loosely around tree trunks and securely fastened to stakes.
- 2.4 LIMESTONE
- A. In accordance with soil test recommendations, provide ground, high magnesium limestone containing not less than 85% total carbonates, 95% passing a 20 mesh sieve, 40% passing a 60 mesh sieve and a minimum of 30% percent passing a 100 mesh sieve.
- 2.6 MULCH
- A. Double shredded hardwood bark. To be natural in color, free of dye.
- 2.7 WATER
- A. Potable, clean fresh and free from harmful materials.
- 2.8 HERBICIDES
- A. Herbicides, fungicides, and pesticides: Approved before use for type and rate of application by Owner and local, state and/or federal agencies with jurisdiction. Spraying of all herbicides shall be done in accordance with the Chemical Spraying Program.
    1. Non-selective herbicide shall be Round-Up as manufactured by Monsanto or approved equal.
  - B. A standard complete slow release fertilizer. At least 50% by weight of the nitrogen content of the fertilizer shall be derived from organic materials with the remainder in urea form or equivalent. Fertilizer shall contain percent nitrogen, phosphorous, and potash by weight of ingredients dictated by the topsoil test results.
    1. Fertilizer shall be in bags showing weight, analysis, and manufacturer's name.

## 2.9. PROTECTION MATERIALS

- A. Wood stakes, suitable in length so that 30" minimally is exposed above ground.
- B. Durable twine with fluorescent flagging.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that previously installed protection measures are in place.
- B. Verify that excavation and grading is complete.
- C. Do not begin planting and lawn work until all other work is complete. Planting areas shall be free of waste and debris generated by other construction activities.
- D. Beginning installation means acceptance of existing conditions.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees from damage caused by seeding operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Planting Pits:
  - 1. Verify by testing that planting areas are free draining. If planting areas are not free draining notify Owner and submit alternative method of drainage for approval.
  - 2. Stake out location of trees.
    - a. Completely layout planting areas before seeking approval by Landscape Architect and Owner.
  - 3. Planting pits in plant beds shall be excavated to the depth of the rootball and trees shall be planted on undisturbed soil.
    - a. Tree pit excavations shall be circular with vertical sides.
    - b. Install sand, as minimally required, to create a leveling bed under root balls of trees.
    - c. Install 18" of planting soil continuously in plant beds or as indicated on Drawings.
  - 4. Remove all existing materials from tree pits and scarify bottom and sides of planting pits and beds.
  - 5. If an impervious hard plan layer exists in the bottom of the pit after excavation, the pits shall be excavated to the depth of the hardpan or 36 inches below the bottom of the ball. Pit shall then receive a 6 inch layer of AASHTO 57 stone, covered with straw or similar material. Remainder of pit shall be backfilled with topsoil as specified.

### 3.3 PLANT INSTALLATION

- A. Planting:
  - 1. Do not plant until trees and planting pits have been approved by Owner and Landscape Architect.
  - 2. Plant trees to a depth such that the bottom of the trunk flare is 1" above finished grade.
  - 3. Plant upright and plumb and faced to give the best appearance or relationship to adjacent plants and structures.

4. Do not pull burlap out from under balls. Remove platforms, wire and surplus binding to the greatest extent possible. Remove burlap from the top and sides of the rootball to the greatest extent possible. Cleanly cut off all broken or frayed roots.
6. Remove all non-biodegradable materials from the planting area.
7. Carefully place planting soil in six (6) inch lifts to avoid injury to roots and to fill all voids. Firmly tamp each lift to prevent settlement.
8. When the planting area is nearly filled, water and allow to soak away. If planting soil settles after watering, add more planting soil to bring to required level.
9. Upon completion of planting operations, water plants thoroughly over the entire planting bed until fully saturated.
  - a. Apply water slowly to ensure penetration into the entire root system.
10. Mulch within two (2) days of planting. Install two (2) inches of mulch over tree rootballs, and continuously over entire planting beds. Keep mulch at least 2 inches away from tree trunk.
11. Staking and guying shall be done immediately after trees are planted. Trees shall stand plumb after staking.
  - a. Provide a minimum of two (2) stakes per tree.
12. Neatly prune trees to remove broken or badly bruised branches with a clean cut in accordance with NAA standards, and at the time designated by, and to the satisfaction of Owner.
  - a. Preserve the plant's natural character,
  - b. Perform pruning with clean, sharp tools.

### 3.4 PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION

- A. Begin maintenance immediately after each planting area is installed.
  1. Provide all care necessary to keep trees healthy including but not limited to: watering, mulching, weeding, fertilizing, pruning and spraying.
  2. During periods of inadequate rainfall, as determined by the Owner, all plants shall be watered to maintain a constant suitable moisture level for good plant growth. Contractor shall provide all watering hoses and devices. Owner will provide water source.
  3. Weed control shall be by mechanical or hand weeding.
  4. Use of herbicides, insecticides, fungicides, nematicides, fumigants or other chemicals are only acceptable upon approval by the Owner.
- B. Prior to inspection for Substantial Completion remove all excess soil and debris from site and repair damage resulting from planting operations.

### 3.7 PLANT GUARANTEE / ESTABLISHMENT PERIOD

- A. The Establishment Period will begin upon notice of substantial completion by the Owner.
- B. Contractor shall guarantee the plants against defects including death and unsatisfactory growth. Guarantee shall include the purchase of the plants, the rental of any required special equipment necessary to place the plants and the installation of the plants. Contractor shall not be liable for vandalism out of Contractor's control.
- C. New plants installed during the Establishment Period shall carry a new establishment period guarantee equal to the original that begins at the time of acceptance of the replacements plant(s). Replacement and repair work shall be re-inspected by the Owner.
- D. At the end of the Plant Establishment Period, Owner shall make an inspection to determine that all plants are living and healthy. Any replacement of plants at this time shall be made according to the specifications for that type of plant. New plants installed as part of the original two-year guarantee, shall carry a new one-year guarantee period that begins at the time of acceptance of the replacement plant(s). Any replacement and repair work that is required shall be re-inspected by the Owner.

### 3.8 PLANT MAINTENANCE DURING ESTABLISHMENT PERIOD

- A. General: Perform procedures set forth in the submitted and approved maintenance program for the duration of Guarantee Period.
  - 1. Inspect all plants at least once a month to locate any disease or pest infestations. If infestation is present, submit a proposed method of control to Owner for approval prior to application of control measures.
  - 2. Remove dead plants within five (5) business days of notification by Owner or the Owner will remove the plants and bill the Contractor accordingly.
    - a. Replacement plants may be installed during the next appropriate planting season.
    - b. Replacement plants shall be of the same species and size as specified in the Plant List.
  - 3. Perform all maintenance procedures, including but not limited to: fertilizing, watering, weeding, and mulching.
    - a. Prune, as necessary, to remove dead, diseased and damaged branches.
    - b. During periods of inadequate rainfall, all plants shall be watered to maintain a constant suitable moisture level for adequate plant growth. Apply water slowly so as to penetrate the entire root zone. Contractor shall provide water hoses. The Owner shall provide the water source.
    - c. Completely remove, by hand pulling, all weeds within mulch areas. Under no circumstances are weeds to attain more than two (2) inches of growth. Herbicide use is acceptable with Owner approval.
    - d. Restore mulch around trees as necessary to preserve their appearance and to control weed growth.
    - e. If refertilizing of trees is required, apply Ra-Pid-Gro at manufacturer's suggested rate.
    - f. If any tree settles from its proper elevation, raise it to the proper level.
    - g. If spraying to control insects, fungus, and other diseases is required seek approval from Owner before spraying. Furnish a spray program and product information on all sprays to be used to Owner for approval. After approval, application will only be permitted by licensed applicators. Applicators shall follow Notification requirements and report any Chemical Hypersensitivity Registries for the area.

### 3.9 FINAL ACCEPTANCE

- A. At end of Establishment Period, submit a written request to the Owner for Inspection for Final Acceptance at least two (2) weeks prior to the day on which inspection is requested.
- B. At the end of the Establishment Period, Owner and Contractor shall make an inspection to determine that all plants are living and healthy. Any plant that is dead or not in satisfactory condition, as determined by the Owner, shall be removed from the site and replaced in accordance with the specifications.

END OF SECTION 329300

## SECTION 334001 – SOIL PROPERTIES INVESTIGATION

### 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 SCOPE OF WORK

- A. General Site Contractor is required to complete double ring infiltrometer testing at the base of stormwater management systems to confirm any results completed during design and to ensure existing subbase has not been over compacted during excavation and demolition.
- B. The double-ring infiltrometer test is a field method to determine the infiltration of water into soil at locations as specified on the contract documents or in accordance with the minimum requirements by PWD.
- C. Soil classification testing is a field test to determine the general classification of soils per the USDA/NRCS Soils Textural Triangle and Standard Soils Classifications.
- D. Both tests are to be performed in the actual footprint of any proposed stormwater system, prior to any associated demolition or construction activities (aside from those necessary to secure the site for the soil investigation) are completed for the stormwater system in that location.

#### 1.3 REFERENCES

- A. All work and materials under this section shall conform to the following standard specifications where not otherwise required by the Contract Documents (including the Water Department Standard Specifications):
  1. ASTM C 294 Descriptive Nomenclature of Constituents of Natural Mineral Aggregates.
  2. ASTM C 420 Investigating and Sampling Soil and Rock for Engineering Purposes.
  3. ASTM D 1586 Method for Penetration Test and Split-Barrel Sampling of Soils.
  4. ASTM D 1587 Method for Thin-Walled Tube Sampling of Soils.
  5. ASTM D 2487 Test Method for Classification of Soils for Engineering Purposes.
  6. ASTM D 2488 Recommended Practice for Description of Soils (Visual-Manual Procedure).
  7. ASTM D 2573 Method for Field Vane Shear Test in Cohesive Soil.
  8. ASTM D 3385 Infiltration Rate of Soils in Field Using Double-Ring Infiltrometers.
  9. Pennsylvania Department of Environmental Protection (PADEP), Chapter 73, Standards for on-lot sewage treatment facilities, Percolation Test.
  10. Pennsylvania Stormwater Best Management Practices Manual; Appendix C, Soil Evaluation and Soil Infiltration Testing.
  11. National Soil Survey Center (NRCS) Field Book for Describing and Sampling Soils
  12. ASTM D 6913 Test Methods for Particle-Size Distribution of Soils using Sieve Analysis.
  13. National Soil Survey Center (NRCS) Soils Textural Triangle

#### 1.4 SUBMITTALS

- A. Field Records shall include all pertinent information developed. Unofficial copies of field records shall be submitted to the Project Manager within 3 working days of testing.



1. At each assigned site, record the project name and location, and a description of the assigned site. If on Railroad Property, record presence of Railroad Watchmen and other safety personnel.
2. For each testing location, record the assigned number; location; ground surface elevation; name of driller; name of Inspector; day, date, and time work begun; method and apparatus used; details of the character of materials encountered, the depths at which encountered, and the thickness of strata; identification of soils in accordance with ASTM D 2488 and of rock materials in accordance with ASTM C 294; all observations pertaining to groundwater; day, date, and time work completed; time of sunset and/or sunrise; times work interrupted for Standby Time; weather.
3. For each Soil Sample or Rock Core Sample, record the boring number; sample number, method and apparatus used; depth below ground surface; identification of soil or rock material; penetration resistance; core recovery.

B. Final testing logs shall be submitted to the Project Manager as part of the final as-built package.

1. Logs shall be neatly organized reports typed on white bond paper, containing all information from the Field Records, plus results of groundwater observations and physical tests on soil samples, and tabulations of data for soil sampling in a vertical scale of one inch to five feet.
2. Logs shall include a location map indicating the actual location of the testing related by dimension to a fixed point (or points) to remain after construction.

#### 1.5 CONTRACTOR QUALIFICATIONS

A. The infiltration tests for soil shall be performed by a Contractor with at least 5 years of experience in geotechnical engineering services. The Contractor shall have demonstrated experience with infiltration testing in soils. Field supervision by a Professional Geologist or Engineer is required; final testing logs shall be signed and certified by a licensed professional.

#### PART 2 - PRODUCTS

NOT USED.

#### PART 3 - EXECUTION

##### 3.1 SOIL EVALUATIONS

###### A. SAMPLING – GENERAL

1. Sampling shall include split barrel, thin walled tube, hydraulic piston, or test pit sampling as designated herein or as required by the Project Manager. A pilot hole shall be drilled, and all soils shall be sampled every five feet (5') and at changes in strata unless otherwise directed by the Project Manager.
2. Soil sampling shall include (at a minimum) an evaluation of the following conditions, described by initial depth encountered below ground surface:

- a. Soil horizons (upper and lower boundary)
  - b. Soil texture, classification, and color
  - c. Color patterns (mottling) and observed depth
  - d. Depth to water table or redoximorphic effects (if encountered)
  - e. Depth to bedrock (if encountered)
  - f. Observance of pores, roots, voids, or other non-soil components
  - g. Estimated type and percent coarse fragments
  - h. Hardpan or limiting layers encountered
  - i. Strike and dip of horizons (especially lateral direction of flow at limiting layers)
  - j. Any additional comments or observations
3. Sampling shall be done within the proposed footprint of each stormwater system. Additional sampling locations may be proscribed by the Project Manager during the Work to ensure sufficient data collection.
  4. Sampling shall continue to a minimum of two feet (2') beyond the excavated depth of the encompassing system, unless groundwater or bedrock is encountered. Bedrock shall be defined for this requirement as resistant to a blow count greater than fifty (50) blows to drive 12 inches (12").

#### B. SPLIT BARREL SAMPLING

1. Two-inch diameter split barrel samples shall be obtained and resistance to soil penetration shall be measured using the split barrel sampler in accordance with ASTM D 1586. Penetration resistance (blow count) for each 6-inch increment shall be required.
2. The coupling head for the split barrel sampler shall be provided with a ball check valve and shall have open vents. The sampler shall also be equipped with a spring-type sampler retainer or an equivalent retainer acceptable to the Project Manager. The Contractor shall have three complete split barrel samplers on the drill rig. The barrel for the sampler shall be at least 24 inches in length to allow for 2-foot long samples. The split barrel sampler shall be decontaminated after obtaining each sample. Sample jars for split barrel samples submitted for physical analysis shall be supplied by the Contractor and shall not be larger than 2-3/8 inches in diameter. Sample jars for split barrel samples shall be moisture-proof and vapor-proof, wide-mouth glass jars with self-sealing screw covers. Sample jars will be labeled by the geotechnical engineer under the supervision of the Owner/Authorized Representative. The Contractor shall supply labels with space for the job name, boring number, interval sampled, and blow count in 6-inch increments.

#### C. THIN-WALLED TUBE SAMPLING

1. Three-inch diameter thin-walled tube samples shall be obtained using thin-walled tubes in accordance with ASTM D 1587. The coupling head of the thin-walled tube sampler shall be provided with a ball check valve and shall have open vents. Tubes shall be new and coated with a suitable plastic lacquer. Tubes shall recover a sample at least 3 inches in diameter. Tubes shall be furnished in 30-inch lengths and shall be constructed of either seamless steel or welded seam steel, provided welds do not project at the seam. The Contractor shall have eight complete thin-walled tube samplers on the drill rig. Thin-walled tubes will be labeled by the geotechnical engineer under the supervision of the Owner/Authorized Representative. The Contractor shall supply labels with space for job name, boring number, and interval sampled.
2. The coupling head for the thin-walled tube sampler shall be decontaminated after obtaining each sample. Thin-walled tubes shall be decontaminated during the initial decontamination. They shall not be used more than once.
3. The ends of the thin-walled tubes shall be sealed by the Contractor with wax, providing a spacer for partial recovery and taping an air-tight plastic cap over each end of the tube, as approved by the Project Manager.

#### D. HYDRAULIC PISTON SAMPLING

1. Sampling of soft clays and silts shall be performed using a hydraulic piston sampler, as approved by the Project Manager. Piston sampler type and general procedures shall be in accordance with EM 1110-2-1907, Chapter 3. Cased or uncased boreholes in soft soils may have to be supplemented with heavy drilling fluids to assist in retaining the sample in the device and increasing sample recovery. Recovered samples shall be handled and packaged as described for thin-walled tube samples.

E. TEST PIT SAMPLING

1. Test pits are encouraged for all off-street site work. For on-street locations, soil sampling may be appropriate to consider as a limited portion of the excavation for a given system. In either instance, the soil test pit shall consist of a backhoe-excavated trench, three feet (3') wide and to the appropriate depth (two feet beyond the desired system excavated depth). The trench should be benched at a depth of two to three feet (2-3') for access and accessibility.

3.2 INFILTRATION RATE OF SOIL USING DOUBLE-RING INFILTRMETER

- A. The Double-ring Infiltrometer consists of two concentric metal rings. The rings are driven into the ground and filled with water. The outer ring helps to prevent divergent flow. The drop in water level or volume in the inner ring is used to calculate an infiltration rate. The infiltration rate is determined as the amount of water per surface area and time unit that penetrates the soils. The diameter of the inner ring should be approximately 50% to 70% of the diameter of the outer ring, with a minimum inner ring size of 4 inches, preferably much larger (Bower, 1986). Double-ring infiltrometer testing equipment that is designed specifically for this purpose may be purchased.
- B. Conduct a Double-Ring Infiltrometer Field Test as follows:
1. Infiltration testing shall not be performed during any precipitation event or within twenty-four (24) hours after the end of any event equivalent to a half-inch ( $\frac{1}{2}$ " ) or greater. Infiltration testing shall not take place when the temperature is below freezing, or in frozen soils. Tests performed from 1 June to 31 December shall require a twenty-four hour presoaking period prior to testing.
  2. The test requires an area sufficient to set up the equipment (typically ten feet square), and should be nearly level. The test shall be set up at the same elevation as the finished bottom of the proposed stormwater feature. (Usually the lowest excavated elevation.) Excavation shall be performed as necessary to reach this desired elevation (concurrent soils testing is suggested) and provide a stable and level testing location.
    - a. Place outer ring in place; place flat board on ring and drive ring into soil to a minimum depth of two inches
    - b. Place inner ring in place; place flat board on ring and drive ring into soil a minimum of two inches. The bottom rim of both rings should be at the same level.
    - c. The test area should be presoaked immediately prior to testing. Fill both rings with water to water level indicator mark or rim at 30 minute intervals for 1 hour. The minimum water depth should be 4 inches. The drop in the water level during the last 30 minutes of the presoaking period should be applied to the following standard to determine the time interval between readings:
      - a. If the water level drop is 2 inches or more, use 10-minute measurement intervals.
      - b. If the water level drop is less than 2 inches, use 30-minute measurement intervals
  3. Obtain a reading of the drop in water level in the center ring at appropriate time intervals. After each reading, refill both rings to water level indicator mark or rim. Measurement to the water level in the center ring shall be made from a fixed reference point and shall continue at the interval determined until a minimum of eight readings are completed or until a stabilized rate of drop means a difference of  $\frac{1}{4}$  inch or less of drop between the highest and lowest readings of four consecutive readings.

4. The drop that occurs in the center ring during the final period or the average stabilized rate, expressed as inches per hour, shall represent the infiltration rate for that test location.

### 3.3 PAVING RESTORATION

- A. If necessary, following the tests properly abandon the sampling locations to prevent contaminant from entering the groundwater and maintain a safe condition for traffic. Encompassing site protection specified for other parts of the Work of this Contract shall be considered sufficient temporary protection.
- B. The test holes shall be plugged with bentonite or other approved equal plugging material at the bottom or slightly below the groundwater table. Place, up to subgrade elevation, ordinary backfill material (with all stones and other objectionable material removed). Compact the hole plug and ordinary backfill material by tamping.
- C. If not otherwise to be restored or protected, place High Early Strength (H.E.S.) Cement Concrete to match existing surrounding grade. No testing location may be left unprotected and/or unrestored.
- D. Restore grass or other surfacing as appropriate to the satisfaction of the abutting property owners as necessary.

END OF SECTION 334001

## SECTION 334007 - STORMWATER CONTROL STRUCTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The work of this Section consists of the construction of the outflow control structures for stormwater management basins.
- B. All materials shall be manufactured, supplied, stored and placed according to the latest referenced standards and as outlined herein.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.3 SUBMITTALS

- A. Submit complete shop drawings and product information for all items to be furnished under this Section upon receipt of notice to proceed and prior to construction.
- B. Certificates of Compliance: Before installation of any Precast Concrete Products, submit an acceptable Certificate of Compliance to Owner/Authorized Representative
- C. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- D. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified ASTM and ACI requirements.
- E. Submit detailed diagrams of all outflow structure depicting dimensions and materials used to construct the entire structure. Indicate knockout elevations and size for all pipe entering manhole structures or other concrete structures.

#### 1.4 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PWD, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.

### PART 2 - PRODUCTS

#### 2.1 INLET GRATE AND FRAME

- A. Inlet frame and grate shall be in accordance with PennDOT Publication 72M, Roadway Construction Standards RC-45M and PennDOT Publication 408, Section 605.

#### 2.2 PRECAST CONCRETE TOP UNIT, GRADE ADJUSTMENT RINGS, AND INLET BOX

- A. In accordance with PennDOT Publication 408, Section 605.

2.3 CAST BASIN HOOD

- A. Provide Catch Basin Trap Number R-3711 manufactured by Neenah Foundry Inc. or Philadelphia Water department (PWD) approved alternative.

PART 3 - EXECUTION

3.1 INSTALLATION OF OUTFLOW STRUCTURES

- A. Install in accordance with PennDOT Publication 408, Section 605.

END OF SECTION 334007

## SECTION 334009 - CONNECTIONS TO EXISTING STRUCTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY OF WORK

- A. The Work described in this Section shall include all materials, labor, equipment and incidentals required to make connections to structures from stormwater conduit piping as shown on the drawings. All orifice, underdrain, distribution, or other piping that connects to a structure shall have the connection constructed per these Specifications.

#### 1.2 REFERENCES

- A. ASTM C 109, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50 mm Cube Specimens).
- B. ASTM D 638, Test Method for Tensile Properties of Plastics.
- C. ASTM D 695, Test Method for Compressive Properties of Rigid Plastics.

#### 1.3 SUBMITTALS

- A. Before starting this work, submit for approval of Owner/Authorized Representative, manufacturer's literature describing Epoxy Mortar Gel and Epoxy Bonding Agent. Literature must address each requirement (e.g. Compressive Strength per ASTM C109) as specified.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. The following products are acceptable as Epoxy Mortar Gel, provided they continue to meet all requirements:
  - 1. Meta Bond HM Gel, as manufactured by American Meta Seal Company, 509 Washington Avenue, Carlstadt, NJ 07072.
  - 2. Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation, Box 297, Lyndhurst, NJ 07071.
  - 3. Thermal-Chem Mortar Resin Gel (Product No. 304), as manufactured by Thermal-Chem, Inc., 1400 Louis Avenue, Elkgrove, IL 60007.
  - 4. Approved equivalent product.
- B. The following products are acceptable as Epoxy Bonding Agent, provided they continue to meet all requirements:
  - 1. Meta Bond HM, or Meta Bond HM Gel, as manufactured by American Meta Seal Company.
  - 2. Sikastix 370, Sikadur Hi-Mod, or Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation.
  - 3. Thermal-Chem Mortar Resin (Product No. 3), or Thermal-Chem Mortar Resin Gel (Product No. 34), as manufactured by Thermal-Chem, Inc.
  - 4. Approved equivalent product.

#### 2.2 MATERIALS

- A. Epoxy Mortar Gel shall:

1. Be a 100% solids formulation.
2. Have a Tensile Strength per ASTM D 638 not less than 3000 psi after 7 days at 73°F.
3. Have a Tensile Elongation per ASTM D 638 not over 7%.
4. Have a Compressive Strength per ASTM D 695 not less than 3000 psi after 24 hours at 73 degrees F, and not less than 6000 psi after 7 days at 73 degrees F.

B. Sand shall:

1. Be oven-dry silica sand.
2. Have at least 70% by weight pass #20 sieve.
3. Have not over 35% by weight pass #40 sieve.

C. Epoxy Bonding Agent shall meet the requirements for Epoxy Mortar Gel.

2.3 MIXES

- A. Epoxy Mortar shall consist of Epoxy Mortar Gel and Sand mixed at a 1:1 ratio by loose volume.

PART 3 - EXECUTION

3.1 MAKING CONNECTION

- A. Make hole(s) in existing structure as necessary to permit connection. Core through existing concrete structures and cut reinforcing as necessary. Remove all dirt, laitance, and other loose or undesirable material from mating surfaces. Check hole(s) for fit.
- B. Comply fully with manufacturer's instructions. Coat mating surfaces with Epoxy Bonding Agent and set pipe. Seal all openings with Epoxy Mortar. Support pipe securely to prevent movement and protect for at least 24 hours.

END OF SECTION 334009



## SECTION 334200 - STORMWATER CONVEYANCE

### PART 1 - GENERAL

#### 1.1 SUMMARY OF WORK

##### A. Section Includes:

1. Stormwater drainage piping.
2. Inlets and catch basins.
3. Cleanouts
4. Bedding and cover materials.

##### B. Related Requirements:

1. Section 310000 – Earthwork.
2. Section 315000 – Excavation Support and Protection
3. Section 334600 – Stormwater Management.
4. Section 334616 – Outlet Structures for Stormwater Ponds.

#### 1.2 REFERENCE STANDARDS

##### A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Pipe (4-in to 10-in)
2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe (12-in to 36-in)

##### B. American Society for Testing and Materials (ASTM)

1. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).
4. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>).
5. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Application.
6. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
7. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
8. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
9. ASTM F667/F667M - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

##### C. American Water Works Association (AWWA)

1. AWWA C150-08 – Thickness Design of Ductile-Iron pipe.
2. AWWA C151-09 – Ductile-Iron Pipe, centrifugally cast.
3. AWWA C111/A21.11-17 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

##### D. Philadelphia Water Department Quality Certification Standards (QC)

1. QC-2 Standards for Gray/Ductile Iron Castings
2. QC-13 Standards for Thermoplastic Pipe and Fittings

- E. Commonwealth of Pennsylvania, Department of Transportation Specifications, Publication 408 (most recent edition).
  - 1. Bulletin 15, General Index of Approved Product Suppliers.
  - 2. Section 735 – Geotextiles
- F. Where reference is made to one of the above standards the revision in effect at the time of bid opening shall apply.

### 1.3 COORDINATION

- A. Coordinate Work of this Section with termination of storm sewer connection outside building, trenching, connection to foundation drainage system, and municipal sewer utility service.

### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer information describing pipe, pipe accessories, manholes, inlets, catch basins and cleanouts.
- B. Submit shop drawings showing details of pipe, fittings, joints and construction methods.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit special procedures required to install specified products.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statement:
  - 1. Submit qualifications for manufacturer

### 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of pipe runs, connections, catch basins, inlets, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

### 1.6 QUALITY ASSURANCE

- A. HDPE pipe shall be furnished by a manufacturer / facility that is certified by the National Transportation Product Evaluation Program (NTPEP). The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section.
- B. PP pipe shall be furnished by a manufacturer who is fully experienced, reputable, and qualified in the manufacture of the HDPE/PP pipe. The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section.
- C. All gray iron pipe shall be furnished by a manufacturer who is fully experienced, reputable, and qualified in the manufacture of the gray iron pipe. The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section.

- D. All pipe, fittings, cleanout covers, domed riser covers, and other products shall be installed to ensure a minimum loading capacity in accordance with H-20 loading, as required by Philadelphia Department of Streets. Any deviation from manufacturer's specifications for product installation (without approval by manufacturer or signed and sealed statement of adequacy by Professional Engineer) is prohibited.
- E. Maintain one (1) copy of each standard affecting Work of this Section on Site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

#### 1.9 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 CORRUGATED PE PIPING

- A. Pipe:
  - 1. Comply with ASTM F405.
    - a. Type: Smooth interior.
    - b. Inside Nominal Diameter: As Shown on the Drawings.
- B. Fittings: PE.
- C. Joints: Comply with ASTM F405.

#### 2.2 GRAY (CAST) IRON DRAINAGE PIPE AND FITTINGS

- A. Pipe:
  - 1. Comply with ASTM A74.
  - 2. Type: Service.
  - 3. Inside Nominal Diameter: As Shown on the Drawings.
- B. Fittings: Gray Iron

- C. Joints:
  - 1. Comply with ASTM A74.
  - 2. Joint Devices: Rubber gasket.
  
- 2.3 RUBBER SADDLES
  - 1. Rubber Saddles for Lateral Connections to RC Pipe Sewers shall be manufactured from a blend of rubber that is laboratory tested and appropriate for sewer applications.
  - 2. Pipe clamps and expansion rings shall be Type 304 Stainless Steel.
  - 3. Rubber Saddles shall provide a watertight connection and be compatible with ASTM C-923.
  
- 2.4 CATCH BASINS AND INLETS
  - A. Catch Basin:
    - 1. Polyvinyl Chloride (PVC) Catch Basin.
    - 2. Provide catch basin manufactured by Nyloplast and as shown on the contract drawings.
    - 3. PVC Riser section, as needed, manufactured by Nyloplast.
  
  - B. Inlet Frames:
    - 1. Ductile Iron meeting ASTM A536, Grade 70-50-05
    - 2. Manufactured by Nyloplast and as shown on the contract drawings.
  
  - C. Road and Highway Grates:
    - 1. Ductile Iron meeting ASTM A536, Grade 70-50-05
    - 2. Locking
    - 3. Meeting H-20 Load Rating
    - 4. Manufactured by Nyloplast and as shown on the contract drawings.
  
- 2.5 INLET TRAP/INLET HOOD
  - 1. Nyloplast EnviroHood meeting the size of the size of the catch basin as shown on the contract drawings.
  
- 2.6 CLEANOUTS
  - A. Shaft and Top Section:
    - 1. Material: Same material as horizontal pipe section.
    - 2. Joints: Lipped male/female.
    - 3. Nominal Shaft Diameter: Same as horizontal pipe section, 6 inches maximum.
    - 4. Top Section: Concentric cone.
  
  - B. Cleanout Lids and Frames:
    - 1. Materials: Cast iron.
    - 2. Lid:
      - a. Hinged
      - b. Lockable
      - c. Design: Stamped "CLEANOUT"
    - 3. Nominal Lid and Frame Size: 6 inch diameter.
  
  - C. Base Pad:
    - 1. Material: Cast-in-Place concrete as specified in Section 033053 – Site Cast-in-Place Concrete.

## 2.7 DETECTABLE UNDERGROUND TAPE

- A. Detectable Warning Tape shall be six inches wide (6”), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend (“Caution: Buried Storm Sewer Below” or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION CERTIFICATION FORM

- A. The contractor will be required to fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor will be required to make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.
- B. The CCP shall be completed and signed by one of the following:
  - 1. Professional Engineer
  - 2. Registered Architect
  - 3. Landscape Architect
  - 4. Professional Land Surveyor
  - 5. Professional Geologist
  - 6. Licensed Contractor
- C. The contractor shall contact the project’s assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.
- D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
  - 1. Piping
  - 2. Soil
  - 3. Other SMP-related devices or appurtenances.

### 3.2 EXAMINATION

- A. Verify that trench cut is ready to receive Work of this Section.
- B. Verify that excavations, dimensions, and elevations are as indicated on the Drawings.

### 3.3 PREPARATION

- A. Correct over-excavation with coarse aggregate.
- B. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

### 3.4 INSTALLATION OF PIPE

- A. Excavate trench to 12 inches below pipe invert, and as specified in Section 315000 – Excavation Support and Protection.
- B. Hand trim excavation for accurate placement of piping to indicated elevations.

- C. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than one-sixteenth of an inch (1/16") per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site.
- D. All pipe shall be examined before laying and no piece shall be installed which is found to be defective.
- E. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. HDPE pipe and fittings shall be installed in accordance with ASTM D2321 and the requirements of the manufacturer (see "Corrugated HDPE Pipe Installation Guide" from ADS), or as otherwise provided herein or on the Drawings.
- F. After the excavation is complete to normal grade of the bottom of the trench and bottom preparation according to the Drawings and Specifications is completed, crushed stone bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid diameter and hand tools shall be used to force the bedding where needed to give firm continuous support for the pipe. AASHTO #57 aggregate shall then be placed to twelve inches (12") above the top of the pipe. Detectable underground utility marking tape shall be installed over all pipe not otherwise marked. The initial three feet (3') of backfill above the bedding shall be placed in one-foot (1') layers and carefully compacted. Generally the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial three feet (3') of backfill shall be approved by the pipe manufacturer's representative prior to use.
- G. All piping shall be sound and clean before installation. When installation is not in progress for any length of time, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed that recommended by manufacturer.
- H. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.
- I. Precautions shall be taken to prevent flotation of the pipe in the trench.
- J. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below the top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, crushed stone shall be placed to fill any voids created and the backfill shall be recomacted to provide uniform side support for the pipe.
- K. The use of ninety-degree (90°) bend pipe fittings is not permitted in the installation of piping. The Contractor shall use minimum-angle fittings to construct the pipe layout diagrammatically shown in the Drawings. The maximum fitting angle approved for use is forty-five-degrees (45°), and fittings of lesser angles (22½° or 11¼°) are preferred for use where practical.

3.5 BACKFILLING AND COMPACTING PIPES

- A. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by Owner/Authorized Representative.
- B. Place Ordinary Backfill up to three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned. Place Select Backfill Material-2RC for three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned.
- C. Compact backfill around and to a depth of six inches (6") over pipes and fittings by hand tamping. Compact all other backfill in eight-inch (8") layers by mechanical tamping. Puddling is prohibited.
- D. When backfill has been placed to three feet (3') below street surface or finish grade, cut off and remove sheathing and shoring (including soldier beams) two feet (2') below street surface or finish grade. All sheathing and shoring shall be removed in its entirety from excavations for infiltration facilities (tree trenches, basins, etc.).

3.6 INSTALLATION OF INLETS AND CATCH BASINS

- A. Install inlet in accordance with PennDOT Publication 408, Section 605.3.

3.7 TOLERANCES

- A. Maximum Variation from Indicated Pipe Slope: 1/8 inch 10 feet.

3.8 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to and immediately after placing aggregate cover over pipe.
- B. If inspection indicates that Work does not meet specified requirements, remove Work and replace at no additional cost to the Owner.

3.9 CLEANING PIPELINES

- A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed prior to approval and acceptance of the pipe by Owner/Authorized Representative.

END OF DOCUMENT 334200

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## SECTION 334201 – STORMWATER GRAVITY PIPING AND INLETS

### PART 1 - GENERAL

#### 1.1 SUMMARY OF WORK

- A. This section includes all materials and appurtenant work necessary to furnish and install solid and perforated corrugated high density polyethylene (HDPE), polypropylene (PP) pipe, polyvinyl chloride (PVC) pipe, Cast Iron Pipe (CIP), Ductile Iron Pipe (DIP), and/or structures and appurtenances as shown on the Drawings and as specified herein.

#### 1.2 REFERENCE STANDARDS

- A. All sewer work in the public right-of-way under this contract shall be governed by, and done in accordance with the most recent revision or amendment to the Standard Specifications and Standard Details of the Philadelphia Water Department, including the following:
  - 1. Standard Details and Standard Specifications for Sewers.
  - 2. Standard Specifications for Excavation, Refilling, Grading, Landscaping and Repaving.
  - 3. Standard Specifications for Masonry: Concrete.
  - 4. Standard Specifications for Masonry: Stone and Brick.
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - 1. AASHTO M-252 - Standard Specification for Corrugated Polyethylene Pipe (4-in to 10-in)
  - 2. AASHTO M-294 - Standard Specification for Corrugated Polyethylene Pipe (12-in to 36-in)
- C. The Standard Detail for Saddle Connection to RC Pipe Sewers is hereby modified so that the openings for the lateral connections shall be core drilled and rubber saddles shall be substituted in place of clay saddles. The 2000 psi concrete encasement around the saddle shall be extended to the cradle of sewer as shown in the Detail for Resilient Saddle Connection to RC Pipe Sewers affixed to the end of these specifications.
- D. PennDOT Publication 72M, Roadway Construction Standards and PennDOT publication 408, Section 605.
- E. All materials and workmanship shall conform to the most recent revision or amendment to the following standards, except as modified by the Contract Documents:
  - 1. ASTM C 94, Standard Specification for Ready-Mixed Concrete.
  - 2. ASTM C 890, Standard Practice for Installation of Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

#### 1.3 SUBMITTALS

- A. Submit complete shop drawings and product information for all items to be furnished under this Section upon receipt of notice to proceed and prior to construction.
- B. Certificates of Compliance: Before installation of any Precast Concrete Products, submit an acceptable Certificate of Compliance to Owner/Authorized Representative
- C. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- D. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified ASTM and ACI requirements.

- E. Submit detailed diagrams of all outflow structure depicting dimensions and materials used to construct the entire structure. Indicate knockout elevations and size for all pipe entering manhole structures or other concrete structures.

#### 1.4 REGULATORY REQUIREMENTS

- A. Traffic Control: Maintain access of and protection for vehicular and pedestrian traffic as required for construction activities in accordance with local regulations.
- B. Contractor shall obtain all necessary City of Philadelphia Streets Department road opening permits and approvals, Philadelphia Water Department Connection permits and approvals and City of Philadelphia Department of Licenses and Inspections permits and approvals, upon the Contractor receiving Notice to Proceed and prior to proceeding with the Work.

#### 1.5 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.
- B. HDPE pipe shall be furnished by a manufacturer / facility that is certified by the National Transportation Product Evaluation Program (NTPEP). The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this section.
- C. All pipe, fittings, cleanout covers, domed riser covers, and other products shall be installed to ensure a minimum loading capacity in accordance with H-20 loading, as required by Philadelphia Department of Streets. Any deviation from manufacturer's specifications for product installation (without approval by manufacturer or signed and sealed statement of adequacy by Professional Engineer) is prohibited.

### PART 2 - PRODUCTS

#### 2.1 BACKFILL

- A. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by the Owner/Authorized Representative. The Contractor shall furnish any deficiency of Ordinary Backfill Material.
- B. Furnish Select Backfill Material in accordance with PennDOT Publication 408 Specifications, Section 703.3, Select Granular Material-2RC (as amended). The use of slag as Select Backfill Material is hereby prohibited.

#### 2.2 CORRUGATED HDPE OR PP PIPE AND PVC PIPE AND FITTINGS

- A. Corrugated HDPE or PP pipe shall have an annular corrugated exterior and smooth inner wall. Pipe shall be manufactured by an approved supplier under QC-13.
- B. Corrugated pipe shall be high density polyethylene or polypropylene of the size and type as shown on the Drawings, all manufactured by the same company and shall meet or exceed the following specifications as applicable: AASHTO M-252, AASHTO M-294, ASTM F2306, or ASTM F2881. HDPE pipe shall be ADS ST IB N-12 or approved equal. PP pipe shall be ADS N-12 HP or approved equal.

- C. Polyvinyl Chloride Pipe for distribution or drainage piping shall be SDR -35 or ASTM D 3034, Type PSM.
- D. Backfilling over the pipe shall be to ASTM D2321 or the pipe manufacturer's specifications. Cover shall be compacted to at least 95 percent of its maximum dry density as determined by ASTM Test D1557, Method D.
- E. Joints shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
- F. Fittings shall be polyvinyl chloride (PVC) or high-density HDPE of the size and type as shown on the Drawings; all manufactured by the same company and shall meet or exceed the following specifications as applicable: AASHTO M-252, AASHTO M-294, ASTM F2306, and/or ASTM D3034. Fittings shall have bell and spigot connections that utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of ASTM D3212. Fittings shall be manufactured by Nyloplast, ADS, or approved equal.
- G. Perforated pipe shall have AASHTO Class II perforations. Class II perforations shall be located in the outside valleys of the corrugations, be circular and/or slotted, and evenly spaced around the circumference and length of the pipe. The opening area shall be no less than 0.945 square inches per linear foot (pipe diameters 4 through 10-inches).

### 2.3 RUBBER SADDLES

- A. Rubber Saddles for Lateral Connections to RC Pipe Sewers shall be manufactured from a blend of rubber that is laboratory tested and appropriate for sewer applications.
- B. Pipe clamps and expansion rings shall be Type 304 Stainless Steel.
- C. Rubber Saddles shall provide a watertight connection and be compatible with ASTM C-923.

### 2.4 GRAY (CAST) IRON DRAINAGE PIPE

- A. All gray iron pipe shall be manufactured and tested in accordance with ASTM A 74 Standard specification for Cast Iron soil pipe and fittings.
- B. Pipes shall have a nominal laying length of 5 feet and 10 feet for all size diameters.
- C. Pipe shall conform to the Standard Specifications for Gray and Ductile Iron Pipe of PWD.

### 2.5 INLET GRATE AND FRAME

- A. Inlet frame and structural steel bicycle safe grate shall be in accordance with PennDOT Publication 72M, Roadway Construction Standards RC-45M and PennDOT Publication 408, Section 605.

### 2.6 PRECAST CONCRETE TOP UNIT, GRADE ADJUSTMENT RINGS, AND INLET BOX

- A. Concrete top unit type M shall be In accordance with PennDOT Publication 72M, Roadway Construction Standards RC-45M and PennDOT Publication 408, Section 605.

- B. Grade adjustment rings shall be in accordance with PennDOT Publication 72M, Roadway Construction Standards RC-45M and PennDOT Publication 408, Section 605.
- C. Concrete inlet box shall be in accordance with PennDOT Publication 72M, Roadway Construction Standards RC-46M and PennDOT Publication 408, Section 605.

2.7 PWD INLET TRAP

- A. Provide Standard Catch Basin Trap Number 2563 manufactured by Campbell Foundry Company, R-3711 manufactured by Neenah Foundry Inc. or approved alternative.

2.8 4" FRESH AIR INLET

- A. Contractor to furnish and install L&I approved vent covers.
- B. All work and materials to be in accordance with the City of Philadelphia Streets Department standard construction items, Philadelphia plumbing code and PWD sewer service detail.

2.9 CONCRETE MIX

- A. Concrete for sewer lateral connection to be in accordance with PennDOT Publication 408, Section 704 Class C Concrete.

2.10 AREA DRAIN

- A. Provide area drain as indicated on the design plans or approved equal.
- B. Grate to be provided with H-20 vehicle loading.
- C. Size of grate opening and orientation to meet the requirements of the American Disability Act.

2.11 CLEANOUTS

- A. Cleanouts shall be PVC structures in all vertical sections, with adapters to horizontal dual wall corrugated HDPE pipe. Drain covers, grates, and frames shall be ductile iron and lockable. See detailed product information below.
  1. PVC Schedule pipe - Harvel Plastics or approved equal.
  2. PVC Fittings; Universal Bell Adapter - Nyloplast 7001-110-275 or approved equal.
  3. PVC Fitting; 8" HDPE 1/8 Bend - Nyloplast 0894ST or approved equal.
  4. PVC Fitting; 8" HDPE Wye to 6" PVC - Nyloplast 0802AG or approved equal Frame and cover; East Jordan Iron Works 3675 with grate cover and lockable assembly or approved equal. Frame and/or cover to be stamped "CLEANOUT".

2.12 OBSERVATION WELLS

- A. Observation wells shall be four-inch (4") inside diameter rigid Schedule 40 PVC pipe in upper section, with solid cap.
- B. Slotted sections shall be four-inch (4") PVC slotted well with 0.01 slots and attached plug. Atlantic Screen and Manufacturing Item # OE540400 or approved equivalent.
- C. Covers for observation wells shall be lockable ductile iron with gray iron frames, East Jordan Ironworks product #00157024R or approved equivalent. Cover and/or frame shall be stamped "OBS WELL".

- D. Aggregate fill around observation wells shall be consistent with surrounding aggregate.

#### 2.13 DETECTABLE UNDERGROUND TAPE

- A. Detectable Warning Tape shall be six inches wide (6”), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend (“Caution: Buried Storm Sewer Below” or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

### PART 3 - EXECUTION

#### 3.1 MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION

- A. Maintain and protect traffic during construction as required elsewhere in these Contract Documents.

#### 3.2 EXCAVATING

- A. Excavate in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving. Excavation will not be classified, whether by type of material encountered, or by type of equipment required.
- B. Use sheathing and shoring sufficient to avoid damage to or settlement of adjacent buildings, paving, and underground structures.
- C. Protect from damage and provide adequate temporary support for all existing underground facilities, except those known to be abandoned. Repair any damage to existing underground facilities due to Contractor's operations without charge to the Owner.
- D. Use of a Hydro-Hammer or similar equipment for breaking existing paving is hereby prohibited.

#### 3.3 DEBRIS GRILLS

- A. Take great care when breaking the sewer crown to prevent debris from being washed down the sewer.
- B. At the end of each work day, cover the open end of the sewer with a metal debris grill to prevent debris from being washed down or thrown into the sewer during non-work hours. At the beginning of each work day, remove all accumulated debris before removing the debris grill.
- C. Employ a rigid, portable metal debris grill which is sufficiently strong to withstand the impact of any debris which may be washed down stream or thrown against it. Openings shall be 3" x 3".
- D. During working hours, prevent any debris, construction material, or equipment from being washed down the sewer. Remove any such material from the sewer without charge. Use debris grill during working hours when feasible.

#### 3.4 INSTALLATION OF INLETS

- A. Install inlets in accordance with manufacture's specifications and PennDOT Publication 408, Section 605.

- B. Construct inlet connections in accordance with the 1985 Standard Details and Standard Specifications for Sewers, and the Contract Plans and Special Specifications.
- C. All inlets shall be constructed to provide positive drainage. All associated pavement restoration shall be sloped inwards towards the inlet, and the inlet grate or throat as appropriate shall be slightly below the surrounding paving surface. No inlet may be constructed such that its function is restricted, and the Owner/Authorized Representative reserves the right to refuse payment on any inlet that does not provide positive drainage. This may include, but is not limited to, inlets that do not meet the minimum throat opening requirements of four inches (4") after final paving and surfacing is complete, or inlets whose grate is higher than the surrounding paving surface.

### 3.5 INSTALLATION OF PIPES

- A. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than one-sixteenth of an inch (1/16") per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site.
- B. All pipe shall be examined before laying and no piece shall be installed which is found to be defective.
  - 1. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. HDPE pipe and fittings shall be installed in accordance with ASTM D2321 and the requirements of the manufacturer (see "Corrugated HDPE Pipe Installation Guide" from ADS), or as otherwise provided herein or on the Drawings.
- C. After the excavation is complete to normal grade of the bottom of the trench and bottom preparation according to the Drawings and Specifications is completed, crushed stone bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid diameter and hand tools shall be used to force the bedding where needed to give firm continuous support for the pipe. AASHTO #57 aggregate shall then be placed to twelve inches (12") above the top of the pipe. Detectable underground utility marking tape shall be installed over all pipe not otherwise marked (see Section 02709 for pipe within a stone storage trench). The initial three feet (3') of backfill above the bedding shall be placed in one-foot (1') layers and carefully compacted. Generally the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial three feet (3') of backfill shall be approved by the pipe manufacturer's representative prior to use.
- D. All piping shall be sound and clean before installation. When installation is not in progress for any length of time, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed that recommended by manufacturer.
- E. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.
- F. Precautions shall be taken to prevent flotation of the pipe in the trench.

- G. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below the top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, crushed stone shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.
- H. The use of ninety-degree (90°) bend pipe fittings is not permitted in the installation of piping. The Contractor shall use minimum-angle fittings to construct the pipe layout diagrammatically shown in the Drawings. The maximum fitting angle approved for use is forty-five-degrees (45°), and fittings of lesser angles (22½° or 11¼°) are preferred for use where practical.

### 3.6 BACKFILLING AND COMPACTING PIPES

- A. Place and compact backfill in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping and Repaving, except as herein modified.
- B. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by the Owner/Authorized Representative.
- C. Place Ordinary Backfill up to three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned. Place Select Backfill Material-2RC for three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned.
- D. Compact backfill around and to a depth of six inches (6") over pipes and fittings by hand tamping. Compact all other backfill in eight-inch (8") layers by mechanical tamping. Puddling is prohibited.
- E. When backfill has been placed to three feet (3') below street surface or finish grade, cut off and remove sheathing and shoring (including soldier beams) two feet (2') below street surface or finish grade.

### 3.7 OBSERVATION WELLS

- A. Observation wells are typically placed within a subsurface stormwater structure. The well shall be placed in a location similar to that shown on the Drawings.
- B. The well location shall be over-excavated twelve inches (12") below the depth of the surrounding stormwater structure. This excavation shall be performed by hand, so as not to disturb the surrounding soils.
- C. The slotted section of well shall be placed into the over-excavation, with the attached plug at the bottom. A minimum of six inches (6") separation shall be maintained between the top of the slotted well section and the top of the subsurface stormwater structure. Well section length shall be field-adjusted to maintain this separation.
- D. The over-excavation and area surrounding the well within the subsurface stormwater structure shall be backfilled with the same material as the stormwater structure (typically AASHTO #57 stone).
- E. The well section from the slotted section ending six inches (6") below the top of the stormwater structure to the top of the well within the cover shall be four-inch (4") solid Schedule 40 PVC, attached to the slotted section by mechanical means (not PVC cement alone).

- F. The area surrounding the solid well section shall be restored in kind with the adjoining area over the subsurface stormwater structure. Any geotextile wrap separating the stormwater structure from the covering fill shall be cut and wrapped six inches (6") up the solid well section.
- G. The well cover shall be installed within the surface restoration as required, such that the cover plate is flush with the surrounding surface.
- H. The solid well section shall extend into the cover frame enough such that a bentonite seal can be placed around the well within the frame, and a solid slip-on cap can be fitted onto the pipe end.

3.8 AREA DRAIN

- A. The installation of the area drains to be in accordance with the manufacturer's specifications.

3.9 CLEANING PIPELINES

- A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed prior to approval and acceptance of the pipe by Owner/Authorized Representative.

3.10 REPAVING

- A. Restore all disturbed paving, curb and grass areas as required elsewhere in the contract documents.

END OF SECTION 334201



## SECTION 334600 - STORMWATER MANAGEMENT

### PART 1 - GENERAL

#### 1.1 SCOPE DESCRIPTION

- A. The work to be done under this section consists of construction activities pertaining to stormwater management, including but not limited to earthwork and excavation; protection of existing features; preparation of subgrade; check dam construction; grading; sheathing and shoring; placement and compaction of clean stone; construction of stone and/or modular stormwater storage structures; installation of geotextiles, impermeable liners, and rolled erosion control products; installation of velocity dissipators; connection of distribution and drainage piping; backfilling; and any incidental and related operations.
- B. The installation of the Modular storage units shall include any necessary bedding or subgrade preparation not otherwise accounted for, any observation or maintenance ports integral to the modular system, all interfaces required for piping, waterstops, geogrid and geotextile installation, onsite assembly of modular units, and furnishing and installing any additional fittings or appurtenant materials necessary to complete installation of the modular stormwater storage system.

#### 1.2 REFERENCE STANDARDS

- A. The following apply to work in this section:
  - 1. ASTM: Specifications of the American Society for Testing and Materials latest editions. Modifications specified herein shall govern where conflicts with ASTM standards occur.
  - 2. PennDOT: Publication 408 current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications.
  - 3. AASHTO: American Association of State Highway and Transportation Officials, current published standards.
  - 4. PTM: Pennsylvania Test Methods, current published standards.
  - 5. APWA: American Public Works Association, Uniform Color Code.
  - 6. PWD: Philadelphia Water Department Stormwater Management Guidance Manual, latest version
- B. Commonwealth of Pennsylvania, Department of Transportation (PennDOT)
  - 1. Bulletin No. 15: Approved Construction Materials

#### 1.3 SUBMITTALS

- A. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- B. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified requirements. In addition, submit the following:
  - 1. Aggregate:
    - a. Sieve Analysis
    - b. Samples of loose material in sealed bag labeled with the name of the material and manufacturer to be submitted upon request for analysis by the Owner/Authorized Representative. Quantity of sample by weight shall be in accordance with ASTM

standards and may be confirmed by the Philadelphia Water's Bureau of Laboratory Services (BLS) directly at (215) 685-1430.

- c. Report demonstrating that the stone was washed per AASHTO T-11 Standards for less than 0.5% wash loss.
  2. Non-woven geotextile: product manufacturer and specification sheets.
  3. Impermeable liner (if required): product manufacturer and specification sheets.
  4. Modular stormwater storage units: product manufacturer and specification sheets, installation instructions and maintenance guidelines.
  5. Infiltration Testing Report, if required.
- C. Stormwater Storage Modules:
1. Provide a single unit, height as specified in the contract drawings to be reviewed and retained by owner.

#### 1.4 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.
- B. Upon completion of relevant excavation work, and prior to placement of geotextile and aggregate, subgrade soil shall be inspected by owner or authorized representative. Survey or acceptable measurement by the Contractor shall verify the finished subgrade elevation in accordance with the construction plans.
- C. Upon completion of placement of subgrade storage (stone fill or as otherwise specified) and geotextile, and prior to backfilling or surface restoration, the structure shall be inspected by owner or authorized representative. Survey or acceptable measurement by the Contractor shall verify the finished elevation(s) of the subsurface stormwater trench in accordance with the construction plans.
- D. Upon completion of placement of surface stormwater features, and prior to backfilling or surface restoration, the structure shall be inspected by Owner or authorized representative. Survey or acceptable measurement by the Contractor shall verify the finished elevation(s) of all features in accordance with the construction plans.

#### 1.5 DELIVERY STORAGE AND HANDLING

- A. Deliver, store, and handle all materials to ensure protection from damage.
- B. Bagged materials such as fertilizer, lime, etc. shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer and indication of conformance with state and federal laws, as applicable. Containers shall bear the manufacturer's certificate of compliance covering analysis shall be furnished to Owner/Authorized Representative. Store bagged materials in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.
- C. If stored for an extended period of time, additional measures should be taken to prevent UV and weather damage.
- D. Stored components should be checked at least once a week. A check of the stored area should be done to make any minor repairs to the cover or to restack any components that could have fallen over.

PART 2 - PRODUCTS

2.1 AGGREGATE

- A. Coarse aggregates shall meet the following requirements:
1. Maximum wash loss of 0.5% by mass when tested per AASHTO T-11 wash loss test.
  2. Minimum Durability Index of 35 (ASTM D3744)
  3. Maximum abrasion of 10% for 100 revolutions and maximum of 50% for 500 revolutions
  4. All aggregate shall be uniformly graded, clean, and thoroughly washed.
  5. Aggregate shall be 100% crushed material.
- B. Unless otherwise approved by PWD, coarse aggregate for the stormwater trenches shall be uniformly graded as defined in Standard Sizes of Coarse Aggregate, Table 4, AASHTO Specifications, Part I, 19th Ed., 1998, or latest edition, unless otherwise specified.

1. Grading Requirements for AASHTO No. 57

U.S. Standard Sieve Size	Percent Passing
1½" (37.5 mm)	100
1" (25 mm)	95-100
½" (12.5 mm)	25-60
No. 4 (4.75 mm)	0-10
No. 8 (2.36 mm)	0-5

2. Grading Requirements for AASHTO No. 3

U.S. Standard Sieve Size	Percent Passing
2½" (63 mm)	100
2" (50 mm)	90-100
1½" (37.5 mm)	35-70
1" (25 mm)	0-15
½" (12.5 mm)	0-5

- C. Crushed concrete shall not be an acceptable substitute for coarse aggregate.

2.2 SAND

- A. Sand if used or required by the modular manufacture to line the bottom of stormwater trenches shall be AASHTO M-43 No. 9 or 10.
- B. Sand shall not be an acceptable substitute for coarse aggregate.
1. Grading Requirements for AASHTO No 9

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	85-100
No. 8 (2.36 mm)	10-40
No. 16 (1.18 mm)	0-10
No. 50 (300 µm)	0-5

2. Grading Requirements for AASHTO No 10

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	85-100
No. 100 (150 µm)	10-30

2.3 GEOTEXTILES

- A. Non-woven geotextile (drainage filter fabric) consisting of polypropylene fibers.
1. Meeting AASHTO Class 1 or Class 2 Geotextile
  2. Minimum flow rate: 95 gal/min/ft<sup>2</sup> (ASTM D-4491)
  3. Minimum grab tensile strength: 120 lbs (ASTM D-4632)
  4. Minimum Mullen Burst Strength: 225 psi (ASTM D-3786)
  5. Minimum puncture strength (2-in flat-end rod): 660 lbs (ASTM D-6241)
  6. Minimum Trapezoid Tear Strength: 95 lbs (machine direction) and 75 lbs (cross machine direction) (ASTM D-4533)
  7. Minimum UV resistance: 70% retained strength after 500 hrs (ASTM D-4355)
  8. Heat-set or heat-calendared fabrics are not permitted.
- B. Impermeable liner if used shall be 40 mil thick high density polyethylene geomembrane designed specifically for flexible geomembrane applications. Geomembrane liner shall be GSE Lining Technology product # HDE 040A000 or approved equivalent.
1. Minimum average thickness 40 mil (mm) (ASTM D 5199)
  2. Density 0.94 g/cm<sup>3</sup> (ASTM D 1505)
  3. Strength at break 152 lb/in-width
  4. Strength at yield 84 lb/in-width
  5. Elongation at break 700%
  6. Elongation at yield 12%
  7. Tear resistance 28 lb (ASTM D 1004)
  8. Puncture resistance 72 lb (ASTM D 4833)
  9. Carbon black content 2% (ASTM D 5596)
  10. Notched constant tensile load 300 hr (ASTM D 5397, Appendix)
- C. Geotextiles and geogrids associated with modular stormwater systems shall be as specified by the manufacturer.

## 2.4 BACKFILL MATERIALS

- A. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by Owner or authorized representative. The Contractor shall furnish any deficiency of Ordinary Backfill Material.
- B. Select Backfill Material shall be furnished where specified in accordance with PennDOT Publication 408 Specifications, Section 703.3, Select Granular Material-2RC (as amended). The use of slag as Select Backfill Material is hereby prohibited.

## 2.5 WATERSTOPS (ANTI-SEEP COLLARS)

- A. Waterstops (or antiseep collars), if required, shall be quarter-inch ( $\frac{1}{4}$ " ) HDPE sheets cut to the dimensions indicated and installed per the Drawings. All metal fittings or attachments used shall be nylon or stainless steel (Grade 304 or better). Plastic sealant for weld shall be as suggested by manufacturer.

## 2.6 DETECTABLE UNDERGROUND TAPE

- A. Detectable Underground Utility Warning Tape shall be six inches wide (6"), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend ("Caution: Buried Storm Sewer Below" or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

## 2.7 OBSERVATION WELLS

- A. Observation wells shall be four-inch (4") inside diameter rigid Schedule 40 PVC pipe in upper section, with solid cap.
- B. Slotted sections shall be four-inch (4") PVC slotted well with 0.01 slots and attached plug. Atlantic Screen and Manufacturing Item # OE540400 or approved equivalent.
- C. Covers for observation wells shall be lockable ductile iron with gray iron frames, East Jordan Ironworks product #00157024R or approved equivalent. Cover and/or frame shall be stamped "OBS WELL".
- D. Aggregate fill around observation wells shall be consistent with surrounding aggregate.

## 2.8 MODULAR STORMWATER STORAGE SYSTEMS

- A. Modular Stormwater Storage Systems shall be as indicated on the Drawings. Fittings, installation, and appurtenant materials (geogrids, geotextiles, etc) shall be as specified by the manufacturer.
  - 1. ACO Stormbrixx SD as supplied by ACO, Inc.
  - 2. Brentwood Module 20 Series StormTank
  - 3. or Approved equal
- B. The sub-surface stormwater storage system modules under the requires 2.0 ft. cover must withstand, at a minimum live loading consisting of the design truck (HS-20) loading in accordance with AASHTO LRFD Bridge Design Requirements, without geogrid.
- C. The Modular storage units must have a minimum 95% void space.

2.9 MANUFACTURED WATER QUALITY TREATMENT DEVICE

- A. Manufactured treatment devices shall be as indicated on the Drawings. Fittings, installation, and appurtenant materials (geogrids, geotextiles, etc) shall be as specified by the manufacturer.
  - 1. TBD

PART 3 - EXECUTION

3.1 GENERAL CONDITIONS

- A. Coordinate the installation with the product distributor, to have the distributor on-site during product installation.
- B. Review manufacture's installation procedures and coordinate Sub-surface stormwater storage system installation with other work affected, such as grading, excavation, utilities, construction access, erosion control, etc.
- C. Cold weather installation or assembly of modules should not be undertaken when temperatures are below 40°F, without utilization of a heated facility.
- D. Assembled modules may be walked on, but vehicle traffic is prohibited until properly backfilled and covered per Manufacturer's recommendations. Protect personnel and the installation against damage with highly visible construction tape, fencing or other means until construction is complete.

3.2 CONSTRUCTION CERTIFICATION FORM

- A. The contractor will be required to fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor will be required to make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.
- B. The CCP shall be completed and signed by one of the following:
  - 1. Professional Engineer
  - 2. Registered Architect
  - 3. Landscape Architect
  - 4. Professional Land Surveyor
  - 5. Professional Geologist
  - 6. Licensed Contractor
- C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.
- D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
  - 1. Geotextile
  - 2. Stone
  - 3. Storage media
  - 4. Piping
  - 5. Soil
  - 6. Other SMP-related devices or appurtenances.

### 3.3 EXCAVATION BELOW GRADE

- A. Subgrade shall be unfrozen, firm, and stable with no standing water, mud, or muck. If the Contractor fails to maintain the subgrade properly, the Contractor shall remove the unsuitable material at no additional cost to owner. If the bottom of any excavation is taken out below the limits shown on the Drawings, it shall be restored at the Contractor's expense with six inch (6") layers of AASHTO #57 aggregate to the elevations shown in the Drawings. Compacted earthen fill is not acceptable.
- B. If in the opinion of owner or authorized representative the undisturbed natural subgrade, at or below the normal grade of the excavation as indicated on the Drawings, is unsuitable for construction, it shall be removed to such depth and width as owner or authorized representative may direct and be replaced with suitable material as directed. These activities shall be included in the appropriate lump sum price bid for the related construction activities by location.
- C. Excavation of trenches required for the installation of all pipes and structures shall be made to the depths and widths indicated on the Drawings. The Contractor shall render the bottom of the excavations firm and dry and in all respects acceptable to owner or authorized representative. Pavement, when encountered, shall be sawcut along straight lines before excavating.
- D. Excavation shall be performed in the dry and shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The existing subgrade shall not be compacted or subject to excessive construction equipment prior to placement of geotextile and crushed stone. If it is essential that equipment be used in the excavated area of infiltration facilities, all equipment must be approved by PWD or authorized representative. Use of equipment with narrow tracks or tires, rubber tires with large lugs, or high pressure tires that will cause excessive compaction shall not be permitted within the excavation.

### 3.4 EXCAVATION SUPPORT

- A. Furnish, install, monitor and maintain excavation support (e.g., shoring, sheeting, bracing, trench boxes, etc) as required by Federal, State or local laws, ordinances, regulations and safety requirements. Support the sides of excavation, to prevent any movement which could in any way reduce the width of the excavation below that necessary for proper construction and protect adjacent structures from undermining, settlement or other damage.
- B. The Contractor shall take care to prevent the formation of voids outside of sheeting. If voids occur behind sheeting, immediately backfill and compact the voids with AASHTO #57 aggregate. Voids in locations that cannot be properly compacted upon backfilling shall be filled with lean concrete.
- C. All excavation supports shall be carefully removed in such manner so as not to endanger the Work or other adjacent structures, utilities, or property. All voids left or caused by withdrawal of supports shall be immediately filled with crushed stone and compacted. No sheeting shall be left in the trench following installation of improvements.
- D. No payment will be given for sheeting, bracing, etc, during the progress of the work. All payment for installing, maintaining, and removing sheathing and shoring or any other required excavation support shall be included in the appropriate lump sum price bid for the related construction activities by location.

### 3.5 SUBGRADE PREPARATION AND GRADING

- A. Subgrade of infiltration beds shall be level: Plus or minus one-half inch (+/- ½") over ten feet is acceptable as level.

- B. Grading shall be performed to the lines and grades shown on the Drawings. All objectionable material encountered within the limits indicated shall be removed and disposed of by the Contractor.
- C. In excavation faces, all loose or protruding rocks shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the Drawings or as directed by PWD or authorized representative.
- D. Prior to backfill for stone stormwater systems, Double Ring Infiltrometer Testing shall be conducted in one location for each system in accordance with ASTM Standard D 3385: Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer. Test holes shall be located within the limits of the proposed trench excavation and results of the testing shall be submitted to PWD or an authorized representative.
- E. In locations where subsurface stone storage underlies the stormwater surface feature, all work to prepare the stone storage layer shall be completed prior to installation of surface features (see Section 334005). Subsurface stone storage shall be approved by Owner/Authorized Representative prior to installation of surface structures. Appropriate stone foundation shall be utilized in all locations for precast and cast-in-place concrete surrounds and curbing (stone storage may be considered as foundation if compacted stone extends completely under the concrete surrounds).
- F. As-built information of subsurface stone storage and infrastructure below finished grade shall be accurately collected and recorded per PWD and PADEP latest requirements and approved Engineer prior to backfilling.

### 3.6 DISPOSAL OF UNSUITABLE OR SURPLUS MATERIAL

- A. Excavated materials that will not be reused shall be removed from the site of the work and disposed of by the Contractor. Disposal of excavated materials shall be included in the appropriate lump sum price bid for the related construction activities by location, and no additional payment shall be made for disposal of excavated materials regardless of class or condition.
- B. Excavated material shall be stacked without excessive surcharge on the trench bank and without obstructing free access to utilities, private drives and public rights-of-way. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified or shown on the Drawings, and protected.

### 3.7 BACKFILL

- A. Backfill other than planting soil or aggregate as described elsewhere in the Specifications (such as ordinary or select backfill used to fill over-excavation outside installed structures) shall be brought up evenly on all sides in 8-inch maximum lifts (sand layer shall be placed in a single six-inch (6") lift). Each layer of backfill material shall be compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench. Use a pad foot roller for cohesive fill (silts and clay) and a smooth drum roller or vibrating plate for coarse grained fill (sands and gravels). If material is compacted by hand tamping, there must be at least one laborer tamping for each laborer shoveling material into the trench.
- B. Where pipes are laid in off-street easements, the remainder of the trench (one foot (1') or more above the top of the pipe) shall be filled with common fill in layers not to exceed eight inches (8") and compacted by rolling, tamping or vibrating with mechanical compacting equipment. Wherever a loam or gravel surface exists prior to excavations, it shall be removed, conserved



and replaced to the full original depth as part of the work unless specified or shown otherwise. In some areas it may be necessary to remove excess material during the clean up process, so that the ground may be restored to its original level and condition. If the Contractor prefers not to store loam, gravel, or topsoil it shall be replaced with material as specified herein.

- C. Where pipes are laid in PennDOT or local roadways or rights-of-way, the remainder of the trench above the crushed stone backfill and up to the bottom of the specified paving or surface restoration shall be backfilled with fill materials as specified on the Drawings. Lifts shall at no time exceed eight inches (8") loose, and compaction shall be in accordance with these specifications. Preparation and paving shall be performed as shown on the Drawings or as specified herein.

### 3.8 INSTALLATION OF SUBSURFACE STONE

- A. Impermeable liner, non-woven geotextile, and/or sand layer shall be placed immediately after approval of subgrade preparation (to include infiltration testing). Subgrades shall not be subject to compaction during excavation or during installation of geotextile and aggregates. Subgrades shall be hand-raked to scarify bottoms of infiltration systems prior to geotextile and aggregate placement. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of non-woven geotextile at no extra cost to owner.
- B. Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater. Secure non-woven geotextile at least four feet (4') outside of trench and take steps necessary to prevent any runoff or sediment from entering the trench.
- C. Install coarse aggregate in eight inch (8") maximum lifts. Lightly compact each layer with equipment, keeping equipment movement on storage bed subgrades to a minimum. Install aggregate to grades indicated on the drawings. Install detectable underground utility warning tape at the perimeter of the subsurface stone storage trench on all sides. Once aggregate is backfilled and compacted to grades indicated on the Drawings, geotextile shall be folded over and overlapped on top of the bed to prevent soil intrusion into the aggregate bed.
- D. Impermeable liner shall be placed in accordance with manufacturer's instructions and as indicated in the Drawings. All seams and openings in the liner shall be sealed according to manufacturer's recommendations and specifications. Adjacent strips of impermeable liner shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater.
- E. Where an existing utility lateral or branch main intersects the stone stormwater storage system, a pass-through conduit (utility sleeve) shall be constructed to convey the existing utility. Owner's Representative shall review and approve any pass-through conduits for utility lines not indicated on the Drawings, and any utility laterals that may be reconstructed such that a pass-through conduit is not necessary shall be so reconstructed.
  - 1. Pass-through conduits shall be constructed of Schedule 40 PVC pipe of adequate diameter to convey the utility lateral within.
  - 2. Waterstops shall be installed at either end of the pass-through conduit, outside the geotextile wrap of the stone stormwater storage.
  - 3. The conduit shall be of watertight construction, and shall be sealed at either end around the existing pipe with non-shrink grout or sealant.
  - 4. Any pass-through conduits for utilities not indicated on the Drawings found to be necessary upon excavation will be paid at a contingency price.
  - 5. The Contractor shall coordinate sleeving of all existing and intersecting utility lines with the owners/operators of said utility lines.

6. Split Pipe Conduit shall be P6F as manufactured by Conduit Repair Systems or approved equal.

### 3.9 INSTALLATION OF MODULAR SUBSURFACE STORMWATER STORAGE

- A. Installation procedure as follows shall be followed by the Contractor. The Contractor shall also reference the manufacturer's installation guidelines, and where any discrepancy exists owner reserves the right to preempt the manufacturer's installation guidelines as specified herein.
  1. Impermeable liner, non-woven geotextile, and/or sand layer shall be placed immediately after approval of subgrade preparation (to include infiltration testing). Subgrades shall not be subject to compaction during excavation or during installation of geotextile and aggregates. Subgrades shall be hand-raked to scarify bottoms prior to geotextile and aggregate placement. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of non-woven geotextile at no extra cost to owner.
  2. Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Geotextile and other liners shall be placed such that seaming shall be minimized. Additional material to be utilized for wrapping above the structure shall be protected from damage until use. Geotextile used shall be in accordance with modular stormwater unit manufacturer's specifications. Adjacent strips of geotextile shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater. Secure non-woven geotextile at least four feet (4') outside of trench and take steps necessary to prevent any runoff or sediment from entering the trench.
  3. After installation of geotextile as specified above, install base layer of minimum six inches (6") of AASHTO #57 stone across footprint of modular structure. Compact stone to 75-80% relative density per ASTM D4253, and level as necessary to produce a consistent surface. Subgrade shall be visually inspected and approved prior to continuing installation.
  4. Utilize a soluble paint to outline the footprint of the modular units to be placed. Care should be taken to note any connections, observation or maintenance ports, or other irregular units to be placed.
  5. Install modules by placing side-by-side, attaching per manufacturer's instructions. Use caution to avoid debris or soil intrusion to the system components.
  6. Attach all pipe connections, observation or maintenance ports, pass-through conduits, or other intrusions to the system. No penetrations other than manufacturer approved ports shall be placed in top or bottom panels of the system. Support pipe in trenches and during backfill operations to prevent damage. Pipe Connections should extend into the modular system a minimum of 6".
  7. Upon completion of the layer course, wrap geotextile or impermeable liner as specified and backfill around the structure with AASHTO #57 to a minimum of twelve inches (12") width. Side backfill shall be laid in maximum twelve-inch (12") depth lifts and compacted to 75-80% relative density per ASTM D4253. Use caution to avoid damage to the geotextile and other components.
  8. Repeat steps 5-7 as necessary to complete the full modular stormwater system.
  9. Install a twelve inch (12") lift of AASHTO #57 stone over the modular system. Compact to a 75-80% Proctor using vibrating plates or walk-behind non-vibratory rollers (do not use drivable rolling compactors).
  10. Complete geotextile or liner wrap of system. Add any port connections to surface, ensuring a proper seal with geotextile or liner wrap.
  11. Install detectable underground utility marking tape around perimeter of system to mark the area for future utility detection.
  12. Prior to final backfilling and surface restoration, the structure shall be inspected by owner or authorized representative. Survey or acceptable measurement shall verify the finished elevations of the storage structure in accordance with the construction plans.

13. Install remaining cover to a minimum finished cover depth of twenty-four inches (24") as indicated on the plans. Maximum overall depth from surface to invert of system is eleven feet (11'). Complete surface restoration as indicated on the Drawings and as described in Related Work Sections of these specifications.

#### 3.10 INSTALLATION OF ANTISEEP COLLARS (WATERSTOPS)

- A. Antiseep collars shall be installed at transitions between stormwater storage areas and surrounding substances as depicted on the Drawings, or as directed by owner/authorized representative. Geotextile or impermeable liners in place at the interface shall be minimally cut to allow for the pass-through section and then sealed within the solid external sheets of the antiseep collar. All fittings and seals shall be installed to manufacturer's specifications for a watertight seal.
- B. All antiseep collars shall be placed continuously to form a watertight joint. All bends, corners, and splicing shall be made by standard rubber waterstop fittings or by vulcanizing. All collars projecting from the side of the joint shall be protected from damage during construction and be free from defects when the concrete on the adjacent side of the joint is poured in place. All waterstops shall be placed in the center of the joint, with 1/2 of the waterstop on each side of the joint.
- C. All waterstops shall be placed strictly in accordance with the manufacturer's specifications and requirements.

#### 3.11 CLEANING

- A. Perform cleaning during the installation of work and upon completion of the work.
- B. Remove from the site all excess materials, debris, and equipment.

END OF DOCUMENT 334600

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## SECTION 334616 - OUTLET STRUCTURES FOR STORMWATER BASINS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The work of this Section consists of the construction of the outflow control structures for stormwater management basins.
- B. All materials shall be manufactured, supplied, stored and placed according to the latest referenced standards and as outlined herein.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections:
  - 1. Section 334600 – Stormwater Management

#### 1.3 SUBMITTALS

- A. Submit complete shop drawings and product information for all items to be furnished under this Section upon receipt of notice to proceed and prior to construction.
- B. Certificates of Compliance: Before installation of any Precast Concrete Products, submit an acceptable Certificate of Compliance to Owner/Authorized Representative
- C. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- D. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified ASTM and ACI requirements.
- E. Submit detailed diagrams of all outflow structure depicting dimensions and materials used to construct the entire structure. Indicate knockout elevations and size for all pipe entering manhole structures or other concrete structures.

#### 1.4 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.

### PART 2 - PRODUCTS

#### 2.1 OUTLET CONTROL STRUCTURE

- A. Concrete Inlet Box
  - 1. In accordance with PennDOT Publication 408, Section 605.2(d).
  - 2. Internal weir wall to meet same design requirements of the inlet side wall. Extend weir wall reinforcement into the inlet box bottom and side walls. Weir wall shall be poured monolithically with the inlet walls.

- B. Inlet Grate and Frame
  - 1. In accordance with PennDOT Publication 408, Section 605.2(a).
- C. Manhole Steps
  - 1. In accordance with PennDOT Publication 408, Section 605.2(c).
- D. Precast Top Unit
  - 1. In accordance with PennDOT Publication 408, Section 605.2(d).
- E. Inlet Trap/Hood
  - 1. Catch Basin Trap Number R-3711 manufactured by Neenah Foundry Inc. or approved alternative.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF OUTLET CONTROL STRUCTURES

- A. Install in accordance with PennDOT Publication 408, Section 605.3.

#### 3.2 CONSTRUCTION CERTIFICATION FORM

- A. The contractor will be required to fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor will be required to make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.
- B. The CCP shall be completed and signed by one of the following:
  - 1. Professional Engineer
  - 2. Registered Architect
  - 3. Landscape Architect
  - 4. Professional Land Surveyor
  - 5. Professional Geologist
  - 6. Licensed Contractor
- C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.
- D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
  - 1. Geotextile
  - 2. Stone
  - 3. Storage media
  - 4. Piping
  - 5. Soil
  - 6. Other SMP-related devices or appurtenances.

END OF DOCUMENT 334616

## SECTION 334726 - SUBSURFACE STORMWATER STORAGE

### PART 1 - GENERAL

#### 1.1 SCOPE DESCRIPTION

- A. In general, the work to be done under this section consists of construction activities pertaining to subsurface stormwater storage, including but not limited to earthwork and excavation, protection of existing features, preparation of subgrade, grading, sheathing and shoring, placement and compaction of clean stone, construction of stone and/or modular stormwater storage structures, installation of geotextiles and impermeable liners, connection of distribution and drainage piping, backfilling, and any incidental and related operations.
- B. The installation of the Modular storage units shall include any necessary bedding or subgrade preparation not otherwise accounted for, any observation or maintenance ports integral to the modular system, all interfaces required for piping, waterstops, geogrid and geotextile installation, onsite assembly of modular units, and furnishing and installing any additional fittings or appurtenant materials necessary to complete installation of the modular stormwater storage system.

#### 1.2 REFERENCE STANDARDS

- A. The following apply to work in this section:
- B. ASTM: Specifications of the American Society for Testing and Materials latest editions. Modifications specified herein shall govern where conflicts with ASTM standards occur.
- C. PennDOT: Publication 408 current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications.
- D. AASHTO: American Association of State Highway and Transportation Officials, current published standards.
- E. PTM: Pennsylvania Test Methods, current published standards.
- F. APWA: American Public Works Association, Uniform Color Code.
- G. PWD: Philadelphia Water Department Stormwater Management Guidance Manual, latest version

#### 1.3 SUBMITTALS

- A. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- B. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified requirements. In addition, submit the following:
  - 1. Aggregate: sieve analysis
  - 2. Non-woven geotextile: product manufacturer and specification sheets
  - 3. Impermeable liner (if required): product manufacturer and specification sheets.
  - 4. Modular stormwater storage units: product manufacturer and specification sheets, installation instructions and maintenance guidelines.
- C. Submit samples of coarse aggregates and sand.

1. Aggregate and sand: Samples of loose material in sealed bag labeled with name of material and manufacturer to be submitted for analysis by owner. Quantity of sample by weight shall be in accordance with ASTM standards.
2. Sub-surface stormwater storage modules; provide a single unit, height as specified in the contract drawings to be reviewed and retained by owner.

#### 1.4 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.
- B. Upon completion of relevant excavation work, and prior to placement of geotextile and aggregate, subgrade soil shall be inspected by owner or authorized representative. Survey or acceptable measurement by the Contractor shall verify the finished subgrade elevation in accordance with the construction plans.
- C. Upon completion of placement of subgrade storage (stone fill or as otherwise specified) and geotextile, and prior to backfilling or surface restoration, the structure shall be inspected by owner or authorized representative. Survey or acceptable measurement by the Contractor shall verify the finished elevation(s) of the subsurface stormwater trench in accordance with the construction plans.

#### 1.5 DELIVERY STORAGE AND HANDLING

- A. Deliver, store, and handle all materials to ensure protection from damage.
- B. All plastic wrapping from the packaging should be removed and the units should be stored under a tarp or roof where they are protected from weather.
- C. If stored for an extended period of time, additional measures should be taken to prevent UV and weather damage.
- D. Stored components should be checked at least once a week. A check of the stored area should be done to make any minor repairs to the cover or to restack any components that could have fallen over.

### PART 2 - PRODUCTS

#### 2.1 AGGREGATE

- A. Coarse aggregates shall meet the following requirements:
  1. Maximum wash loss of 1% by mass (ASTM C117)
  2. Minimum Durability Index of 35 (ASTM D3744)
  3. Maximum abrasion of 10% for 100 revolutions and maximum of 50% for 500 revolutions
  4. All aggregate shall be clean and thoroughly washed.
  5. Aggregate shall be 100% crushed material.
- B. Unless otherwise approved by PWD, coarse aggregate for the stormwater trenches shall be uniformly graded as defined in Standard Sizes of Coarse Aggregate, Table 4, AASHTO Specifications, Part I, 19th Ed., 1998, or latest edition, unless otherwise specified.
  1. Grading Requirements for AASHTO No. 57



U.S. Standard Sieve Size	Percent Passing
1 ½" (37.5 mm)	100
1" (25 mm)	95-100
½" (12.5 mm)	25-60
No. 4 (4.75 mm)	0-10
No. 8 (2.36 mm)	0-5

2. Any and all other specified coarse aggregates shall conform in gradation and type to the current standards of PennDOT Publication 408, Section 703 Table C.

C. Crushed concrete shall not be an acceptable substitute for coarse aggregate.

## 2.2 SAND

A. Sand if used or required by the modular manufacture to line the bottom of stormwater trenches shall be AASHTO M-43 No. 9 or 10.

B. Sand shall not be an acceptable substitute for coarse aggregate.

1. Grading Requirements for AASHTO No 9

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	85-100
No. 8 (2.36 mm)	10-40
No. 16 (1.18 mm)	0-10
No. 50 (300 µm)	0-5

2. Grading Requirements for AASHTO No 10

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	85-100
No. 100 (150 µm)	10-30

## 2.3 GEOTEXTILES

A. Non-woven geotextile (drainage filter fabric) minimum 6 oz.

1. Minimum flow rate 95 gal/min/ft<sup>2</sup> (ASTM D-4491)
2. Minimum grab tensile strength 120 lbs (ASTM D-4632)
3. Minimum CBR puncture strength 300 psi (ASTM D-6241)
4. Minimum tear resistance 50 lbs (ASTM D-4533)
5. Minimum UV resistance 70% retained strength (ASTM D-4355)

- B. Impermeable liner if used shall be 40 mil thick high density polyethylene geomembrane designed specifically for flexible geomembrane applications. Geomembrane liner shall be GSE Lining Technology product # HDE 040A000 or approved equivalent.
  - 1. Minimum average thickness 40 mil (mm) (ASTM D 5199)
  - 2. Density 0.94 g/cm<sup>3</sup> (ASTM D 1505)
  - 3. Strength at break 152 lb/in-width
  - 4. Strength at yield 84 lb/in-width
  - 5. Elongation at break 700%
  - 6. Elongation at yield 12%
  - 7. Tear resistance 28 lb (ASTM D 1004)
  - 8. Puncture resistance 72 lb (ASTM D 4833)
  - 9. Carbon black content 2% (ASTM D 5596)
  - 10. Notched constant tensile load 300 hr (ASTM D 5397, Appendix)
- C. Geotextiles and geogrids associated with modular stormwater systems shall be as specified by the manufacturer.

#### 2.4 BACKFILL MATERIALS

- A. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by PWD or authorized representative. The Contractor shall furnish any deficiency of Ordinary Backfill Material.
- B. Select Backfill Material shall be furnished where specified in accordance with PennDOT Publication 408 Specifications, Section 703.3, Select Granular Material-2RC (as amended). The use of slag as Select Backfill Material is hereby prohibited.

#### 2.5 WATERSTOPS

- A. Waterstops (or antiseep collars) if required shall be quarter-inch (1/4") HDPE sheets cut to the dimensions indicated and installed per the Drawings. All metal fittings or attachments used shall be nylon or stainless steel (Grade 304 or better). Plastic sealant for weld shall be as suggested by manufacturer.

#### 2.6 DETECTABLE UNDERGROUND TAPE

- A. Detectable Underground Utility Warning Tape shall be six inches wide (6"), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend ("Caution: Buried Storm Sewer Below" or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

#### 2.7 MODULAR STORMWATER STORAGE SYSTEMS

- A. Modular Stormwater Storage Systems shall be as indicated on the Drawings. Fittings, installation, and appurtenant materials (geogrids, geotextiles, etc) shall be as specified by the manufacturer.
  - 1. Brentwood Module 20 Series StormTank or Approved equal.
- A. The sub-surface stormwater storage system modules under the requires 2.0 ft. cover must withstand, at a minimum live loading consisting of the design truck (HS-20) loading in accordance with AASHTO LRFD Bridge Design Requirements, without geogrid.
- B. The Modular storage units must have a 95% void space.

## PART 3 - EXECUTION

### 3.1 GENERAL CONDITIONS

- A. Coordinate the installation with the product distributor, to have the distributor on-site during product installation.
- B. Review manufacture's installation procedures and coordinate Sub-surface stormwater storage system installation with other work affected, such as grading, excavation, utilities, construction access, erosion control, etc.
- C. Cold weather installation or assembly of modules should not be undertaken when temperatures are below 40°F, without utilization of a heated facility.
- D. Assembled modules may be walked on, but vehicle traffic is prohibited until properly backfilled and covered per Manufacturer's recommendations. Protect personnel and the installation against damage with highly visible construction tape, fencing or other means until construction is complete.

### 3.2 EXCAVATION BELOW GRADE

- A. Subgrade shall be unfrozen, firm, and stable with no standing water, mud, or muck. If the Contractor fails to maintain the subgrade properly, the Contractor shall remove the unsuitable material at no additional cost to owner. If the bottom of any excavation is taken out below the limits shown on the Drawings, it shall be restored at the Contractor's expense with six inch (6") layers of AASHTO #57 aggregate to the elevations shown in the Drawings. Compacted earthen fill is not acceptable.
- B. If in the opinion of owner or authorized representative the undisturbed natural subgrade, at or below the normal grade of the excavation as indicated on the Drawings, is unsuitable for construction, it shall be removed to such depth and width as owner or authorized representative may direct and be replaced with suitable material as directed. These activities shall be included in the appropriate lump sum price bid for the related construction activities by location.
- C. Excavation of trenches required for the installation of all pipes and structures shall be made to the depths and widths indicated on the Drawings. The Contractor shall render the bottom of the excavations firm and dry and in all respects acceptable to owner or authorized representative. Pavement, when encountered, shall be sawcut along straight lines before excavating.
- D. Excavation shall be performed in the dry and shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The existing subgrade shall not be compacted or subject to excessive construction equipment prior to placement of geotextile and crushed stone. If it is essential that equipment be used in the excavated area of infiltration facilities, all equipment must be approved by PWD or authorized representative. Use of equipment with narrow tracks or tires, rubber tires with large lugs, or high pressure tires that will cause excessive compaction shall not be permitted within the excavation.

### 3.3 EXCAVATION SUPPORT

- A. Furnish, install, monitor and maintain excavation support (e.g., shoring, sheeting, bracing, trench boxes, etc) as required by Federal, State or local laws, ordinances, regulations and safety requirements. Support the sides of excavation, to prevent any movement which could in any way reduce the width of the excavation below that necessary for proper construction and protect adjacent structures from undermining, settlement or other damage.

- B. The Contractor shall take care to prevent the formation of voids outside of sheeting. If voids occur behind sheeting, immediately backfill and compact the voids with AASHTO #57 aggregate. Voids in locations that cannot be properly compacted upon backfilling shall be filled with lean concrete.
- C. All excavation supports shall be carefully removed in such manner so as not to endanger the Work or other adjacent structures, utilities, or property. All voids left or caused by withdrawal of supports shall be immediately filled with crushed stone and compacted. No sheeting shall be left in the trench following installation of improvements.
- D. No payment will be given for sheeting, bracing, etc, during the progress of the work. All payment for installing, maintaining, and removing sheathing and shoring or any other required excavation support shall be included in the appropriate lump sum price bid for the related construction activities by location.

#### 3.4 SUBGRADE PREPARATION AND GRADING

- A. Subgrade of infiltration beds shall be level: Plus or minus one-half inch (+/- 1/2") is acceptable as level.
- B. Grading shall be performed to the lines and grades shown on the Drawings. All objectionable material encountered within the limits indicated shall be removed and disposed of by the Contractor.
- C. In excavation faces, all loose or protruding rocks shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the Drawings or as directed by PWD or authorized representative.
- D. Prior to backfill for stone stormwater systems, Double Ring Infiltrometer Testing shall be conducted in one location for each system in accordance with ASTM Standard D 3385: Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer. Test holes shall be located within the limits of the proposed trench excavation and results of the testing shall be submitted to PWD or an authorized representative.

#### 3.5 DISPOSAL OF UNSUITABLE OR SURPLUS MATERIAL

- A. Excavated materials that will not be reused shall be removed from the site of the work and disposed of by the Contractor. Disposal of excavated materials shall be included in the appropriate lump sum price bid for the related construction activities by location, and no additional payment shall be made for disposal of excavated materials regardless of class or condition.
- B. Excavated material shall be stacked without excessive surcharge on the trench bank and without obstructing free access to utilities, private drives and public rights-of-way. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified or shown on the Drawings, and protected as specified in Section 02270.

#### 3.6 BACKFILL

- A. Backfill shall be brought up evenly on all sides in 8-inch maximum lifts (sand layer shall be placed in a single six-inch (6") lift). Each layer of backfill material shall be compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench. Use a pad foot roller for cohesive fill (silts and clay) and a smooth drum roller or vibrating plate for coarse grained fill (sands and gravels). If material is compacted by hand

tamping, there must be at least one laborer tamping for each laborer shoveling material into the trench.

- B. Where pipes are laid in off-street easements, the remainder of the trench (one foot (1') or more above the top of the pipe) shall be filled with common fill in layers not to exceed eight inches (8") and compacted by rolling, tamping or vibrating with mechanical compacting equipment. Wherever a loam or gravel surface exists prior to excavations, it shall be removed, conserved and replaced to the full original depth as part of the work unless specified or shown otherwise. In some areas it may be necessary to remove excess material during the clean up process, so that the ground may be restored to its original level and condition. If the Contractor prefers not to store loam, gravel, or topsoil it shall be replaced with material as specified herein.
- C. Where pipes are laid in PennDOT or local roadways or rights-of-way, the remainder of the trench above the crushed stone backfill and up to the bottom of the specified paving or surface restoration shall be backfilled with fill materials as specified on the Drawings. Lifts shall at no time exceed eight inches (8") loose, and compaction shall be in accordance with these specifications. Preparation and paving shall be performed as shown on the Drawings or as specified herein.

### 3.7 INSTALLATION OF SUBSURFACE STONE STORMWATER TRENCHES

- A. Impermeable liner, non-woven geotextile, and/or sand layer shall be placed immediately after approval of subgrade preparation (to include infiltration testing). Subgrades shall not be subject to compaction during excavation or during installation of geotextile and aggregates. Subgrades shall be hand-raked to scarify bottoms of infiltration systems prior to geotextile and aggregate placement. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of non-woven geotextile at no extra cost to owner.
- B. Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater. Secure non-woven geotextile at least four feet (4') outside of trench and take steps necessary to prevent any runoff or sediment from entering the trench.
- C. Install coarse aggregate in eight inch (8") maximum lifts. Lightly compact each layer with equipment, keeping equipment movement on storage bed subgrades to a minimum. Install aggregate to grades indicated on the drawings. Install detectable underground utility warning tape at the perimeter of the subsurface stone storage trench on all sides. Once aggregate is backfilled and compacted to grades indicated on the Drawings, geotextile shall be folded over and overlapped on top of the bed to prevent soil intrusion into the aggregate bed.
- D. Impermeable liner shall be placed in accordance with manufacturer's instructions and as indicated in the Drawings. All seams and openings in the liner shall be sealed according to manufacturer's recommendations and specifications. Adjacent strips of impermeable liner shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater.
- E. Where an existing utility lateral or branch main intersects the stone stormwater storage system, a pass-through conduit (utility sleeve) shall be constructed to convey the existing utility. PWD shall review and approve any pass-through conduits for utility lines not indicated on the Drawings, and any utility laterals that may be reconstructed such that a pass-through conduit is not necessary shall be so reconstructed.
  - 1. Pass-through conduits shall be constructed of Schedule 40 PVC pipe of adequate diameter to convey the utility lateral within.
  - 2. Waterstops shall be installed at either end of the pass-through conduit, outside the geotextile wrap of the stone stormwater storage.

3. The conduit shall be of watertight construction, and shall be sealed at either end around the existing pipe with non-shrink grout or sealant.
4. Any pass-through conduits for utilities not indicated on the Drawings found to be necessary upon excavation will be paid at a contingency price.
5. The Contractor shall coordinate sleeving of all existing and intersecting utility lines with the owners/operators of said utility lines.
6. Split Pipe Conduit shall be P6F as manufactured by Conduit Repair Systems or approved equal.

### 3.8 INSTALLATION OF MODULAR SUBSURFACE STORMWATER STORAGE.

- A. Installation procedure as follows shall be followed by the Contractor. The Contractor shall also reference the manufacturer's installation guidelines, and where any discrepancy exists owner reserves the right to preempt the manufacturer's installation guidelines as specified herein.
1. Impermeable liner, non-woven geotextile, and/or sand layer shall be placed immediately after approval of subgrade preparation (to include infiltration testing). Subgrades shall not be subject to compaction during excavation or during installation of geotextile and aggregates. Subgrades shall be hand-raked to scarify bottoms prior to geotextile and aggregate placement. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of non-woven geotextile at no extra cost to owner.
  2. Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater. Secure non-woven geotextile at least four feet (4') outside of trench and take steps necessary to prevent any runoff or sediment from entering the trench.
  3. After installation of geotextile as specified above, install base layer of minimum six inches (6") of AASHTO #57 stone across footprint of modular structure. Compact stone to 75-80% relative density per ASTM D4253, and level as necessary to produce a consistent surface. Subgrade shall be visually inspected and approved prior to continuing installation.
  4. Place geotextile fabric and/or impermeable liner if required as specified to full extents of excavation. Geotextile shall be installed per manufacturer's directions. Geotextile and other liners shall be placed such that seaming shall be minimized. Additional material to be utilized for wrapping above the structure shall be protected from damage until use. Geotextile used shall be in accordance with modular stormwater unit manufacturer's specifications.
  5. Utilize a soluble paint to outline the footprint of the modular units to be placed. Care should be taken to note any connections, observation or maintenance ports, or other irregular units to be placed.
  6. Install modules by placing side-by-side, attaching per manufacturer's instructions. Use caution to avoid debris or soil intrusion to the system components.
  7. Attach all pipe connections, observation or maintenance ports, pass-through conduits, or other intrusions to the system. No penetrations other than manufacturer approved ports shall be placed in top or bottom panels of the system. Support pipe in trenches and during backfill operations to prevent damage. Pipe Connections should extend into the modular system a minimum of 6".
  8. Upon completion of the layer course, wrap geotextile or impermeable liner as specified and backfill around the structure with AASHTO #57 to a minimum of twelve inches (12") width. Side backfill shall be laid in maximum twelve-inch (12") depth lifts and compacted to 75-80% relative density per ASTM D4253. Use caution to avoid damage to the geotextile and other components.
  9. Repeat steps 1-6 as necessary to complete the full modular stormwater system.
  10. Complete geotextile or liner wrap of system. Add any port connections to surface, ensuring a proper seal with geotextile or liner wrap.

11. Install detectable underground utility marking tape around perimeter of system to mark the area for future utility detection.
12. Prior to final backfilling and surface restoration, the structure shall be inspected by owner or authorized representative. Survey or acceptable measurement shall verify the finished elevations of the storage structure in accordance with the construction plans.
13. Upon approval under the provisions of step 10, install a twelve inch (12") lift of AASHTO #57 stone over the modular system. Compact to a 95% Proctor using vibrating plates or walk-behind non-vibratory rollers (do not use drivable rolling compactors). Driving on modules is prohibited until a minimum twenty-four inches (24") of cover is established.
14. Install remaining cover to a minimum finished cover depth of twenty-four inches (24") as indicated on the plans. Maximum overall depth from surface to invert of system is eleven feet (11'). Complete surface restoration as indicated on the Drawings and as described in Related Work Sections of these specifications.

### 3.9 INSTALLATION OF ANTISEEP COLLARS (WATERSTOPS)

- A. Antiseep collars shall be installed at transitions between stormwater storage areas and surrounding substances as depicted on the Drawings, or as directed by owner/authorized representative. Geotextile or impermeable liners in place at the interface shall be minimally cut to allow for the pass-through section and then sealed within the solid external sheets of the antiseep collar. All fittings and seals shall be installed to manufacturer's specifications for a watertight seal.
- B. All antiseep collars shall be placed continuously to form a watertight joint. All bends, corners, and splicing shall be made by standard rubber waterstop fittings or by vulcanizing. All collars projecting from the side of the joint shall be protected from damage during construction and be free from defects when the concrete on the adjacent side of the joint is poured in place. All waterstops shall be placed in the center of the joint, with 1/2 of the waterstop on each side of the joint.
- C. All waterstops shall be placed strictly in accordance with the manufacturer's specifications and requirements.

### 3.10 CLEANING

- A. Perform cleaning during the installation of work and upon completion of the work.
- B. Remove from the site all excess materials, debris, and equipment.

END OF SECTION 334726

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