



ISSUED FOR BID

Issaquah Elevator Pit Water Intrusion Mitigation

CONTRACT NO. RTA/CN

0177-25 VOLUME 2 OF 3

CONTRACT SPECIFICATIONS

AUGUST, 2026

SOUND TRANSIT

Issaquah Elevator Pit Water Intrusion Mitigation
Water Intrusion and Sump Pump Remediation



SPECIFICATIONS

DESIGNED BY: WSP
1001 Fourth Street
Suite 3100
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DATE ISSUED: March 31, 2026

PROJECT NO.: WSP: US-WSP-30903027.000
ST: TRA/OA 0037-23B, TO 12

SECTION 00 00 10

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Note:

Items with an asterisk (*) are Sound Transit (ST) Standard Specifications.

Items with a plus (+) are Sound Transit (ST) Standard Specifications with consultant modifications.

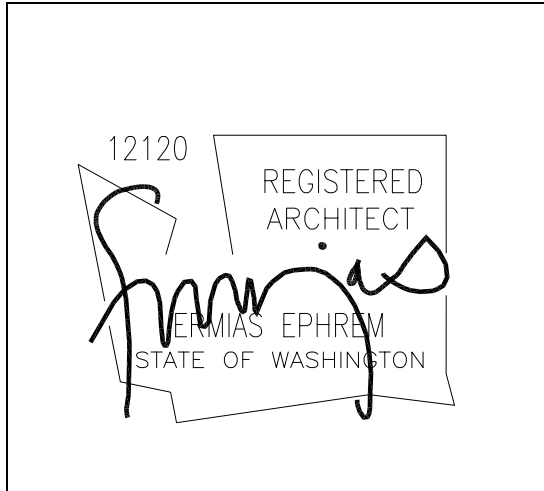
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SECTION 01 01 07

SEALS PAGE

The Professional seals and signatures affixed hereon indicate the professionals' review and participation in the preparation of the Contract Specifications.



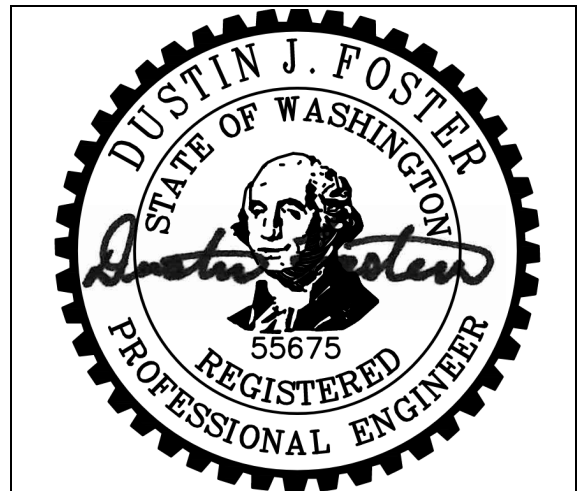
Ermias Ephrem, RA
Divisions: 02- 09 (non-'ST' sections)



Jason Necessary, PE
Divisions: 22



Samir Chudgar, PE
Divisions: 02- 09



Dustin Foster, PE
Divisions: 26

Div 1

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.01 SUMMARY

- A. The Work of this Contract includes, but is not limited to, construction of:
1. Replacement of elevator shaft roof.
 2. Replacement of water-damaged exterior cladding/panels at the elevator shaft landings on Levels 1, 2, and 3.
 3. Replacement of interior gypsum wallboard and sealant repairs within the elevator shaft at landings on Levels 1, 2, and 3.
 4. Installation of waterproofing and a sump pump system in the elevator pit, including associated controls and piping routed to the adjacent janitor room.
 5. Installation of structural supports and glazed curtainwall systems along the north and west exterior frontages of the parking garage.
 6. Installation of cable barriers near the northwest corner of the garage at Levels 2, 3, and 4.
 7. Relocation of light fixtures and security cameras impacted by the curtainwall installation.

1.02 SPECIFICATION LANGUAGE

- A. Contract Specifications are written mostly in imperative and streamlined form. Unless indicated otherwise, this imperative language is directed to the Contractor. Additionally, the words "shall be" shall be included by inference where a colon (:) is used within sentences or phrases.
1. Examples:
 - a. Aggregate: ASTM C33.
 - b. Adhesive: Spread with notched trowel.
- B. Whenever there is wording stating that an item is "as specified," "as indicated," or "as shown," the reference is to all Contract Specifications and all Contract Drawings in the Contract Documents. Stating "as specified," "as indicated," or "as shown" does not refer necessarily to a Contract Drawing or Contract Specification but refers to either.
- C. Furnish, Provide and Supply: Furnish means to supply and deliver to the Project Site, ready for installation. Provide means to furnish, install, and incorporate into the Work, including all labor, materials, supplies and equipment, including testing and commissioning necessary to do so, complete and ready for intended use. Supply means to acquire, deliver, and transfer the item to Sound Transit as specified.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 20 00.20
PRICE AND PAYMENT PROCEDURES
DESIGN-BID-BUILD

PART 1 - GENERAL

1.01 SUMMARY

This Section includes requirements for measurement and payment as they apply to the Work, including provisions applicable to lump sum, provisional sum and unit price items.

1.02 SUBMITTALS

A. Formats:

1. Hard Copy: 8-1/2 inches by 11 inches in size
2. Electronic Copy: Microsoft Excel and .PDF formats

B. Schedule of Values (SOV):

1. Draft Schedule of Values: Within 30 days of the effective date of the Notice to Proceed (NTP)
2. Final Schedule of Values: Within 60 days of the effective date of the NTP
3. Revised Schedule of Values: As required

C. Conform re-submittals to the same requirements as the original submittals.

1.03 SCHEDULE OF VALUES

- A. Develop and use the Schedule of Values to provide an allocation of the Work for measurement and payment to an appropriate level of detail to ensure accurate payment for the Work accomplished.**
- B. Obtain the agreement of the Resident Engineer on the Schedule of Values. No payment will be made prior to an agreed upon Schedule of Values.**
- C. Include an updated version of the Schedule of Values with each progress payment request. Update the Schedule of Values to include:**
1. Dollars earned and percent complete for the current progress payment period
 2. Dollars earned and percent complete to-date, excluding the current progress payment period
 3. Total dollars earned and percent complete to-date
 4. Total dollars remaining
 5. Changes resulting from Change Orders

- D. The total value of the line items in the Schedule of Values plus any approved Change Orders shall be equal to the current contract price.
- E. The value of stored material shall be identified in the Schedule of Values with both a material-purchase activity and a separate corresponding installation activity in the Construction Schedule(s).
- F. If required by the Resident Engineer, present documentation substantiating the cost allocations for line items within the Schedule of Values.
- G. On the 25th of each month or next business day, if the 25th falls on a weekend or holiday, meet with the Resident Engineer to discuss the monthly progress payment.

1.04 LUMP-SUM MEASUREMENT

Lump-sum measurement will be for the entire item, unit of Work, structure, or combination thereof, as specified and as indicated in the Contract Price Schedule.

- A. If the Contractor requests progress payments for lump-sum items or amounts in the Contract Price Schedule, such progress payments will be made in accordance with a well-balanced, detailed schedule of values for payment-apportioning, prepared by the Contractor and submitted to the Resident Engineer for approval.
- B. Each applicable lump-sum item shall show fixed, definable and measurable quantities where possible and unit prices as developed and assigned by the Contractor to the different features of the Work and major subdivisions thereof. The summation of 1) extensions of quantities and unit prices and 2) other related lump sum costs shall equal the lump sum price of the item as shown in the Contract Price Schedule.
- C. Following the Resident Engineer's approval, this price breakdown shall be incorporated into the Schedule of Values, from which progress payments will reflect the progress expressed in earned value that occurred during the payment period as approved by the Resident Engineer.

1.05 MEASUREMENT OF QUANTITIES FOR UNIT PRICES

- A. Measurement Standards:
 - 1. All Work to be paid for at a contract price per unit measurement, as indicated in the Contract Price Schedule, will be measured by the Resident Engineer in accordance with United States Standard Measures.
 - 2. A ton shall consist of 2,000 pounds avoirdupois.
- B. Measurement by Weight:
 - 1. Reinforcing steel, steel shapes, castings, miscellaneous metal, metal fabrications, and similar items to be paid for by weight shall be measured by scale or by handbook weights for the type and quantity of material actually furnished and incorporated into the Work.
 - 2. Unless shipped by rail, material to be measured and paid for by weight shall be weighed on sealed scales regularly inspected by the Washington State Department of Agriculture's Weights and Measures Section or its designated representative, furnished by and at the expense of the Contractor. All weighing, measuring, and metering devices shall be suitable for the purpose intended and shall conform to the tolerances and specifications as outlined in Washington State Department of Transportation Standard Specifications, Division 1, General Requirements, Article 1-09.2, Weighing Equipment.

3. Provide or utilize platform scales of sufficient size and capacity to permit the entire vehicle or combination of vehicles to rest on the scale platform while being weighed. Combination vehicles may be weighed as separate units provided they are disconnected while being weighed. Scales shall be inspected and certified as often as the Resident Engineer may deem necessary to ascertain accuracy. Costs incurred as a result of regulating, adjusting, testing, inspecting, and certifying scales shall be borne by the Contractor.
4. A licensed weighmaster shall weigh all Contractor-furnished materials. The Resident Engineer may be present to witness the weighing and to check and compile the daily record of such scale weights. However, in any case, the Resident Engineer will require that the Contractor furnish weight slips and daily summary weigh sheets. In such cases, furnish a duplicate weight slip or a load slip for each vehicle weighed, and deliver the slip to the Resident Engineer at the point of delivery of the material.
5. If the material is shipped by rail, the certified car weights will be accepted, provided only actual weight of material will be paid for and not minimum car weights used for assessing freight tariff. Car weights will not be acceptable for material to be passed through mixing plants. Material to be measured by weight shall be weighed separately for each bid item under which it is to be paid.
6. Trucks used to haul material being paid for by weight shall be weighed empty daily and at such additional times as the Resident Engineer may require. Each truck shall bear a plainly legible identification mark. The Resident Engineer may require the weight of the material verified by weighing empty and loaded trucks on such other scales as the Resident Engineer may designate.

C. Measurement by Volume:

1. Measurement by volume will be by the cubic dimension indicated in the Contract Price Schedule. Method of volume measurement will be by the unit volume in place or removed as shown on the Contract Drawings or as specified.
2. When material is to be measured and paid for on a volume basis and it is impractical to determine the volume by the specified method of measurement, or when requested by the Contractor in writing and accepted by the Resident Engineer in writing, the material may be weighed in accordance with the requirements specified for weight measurement. Such weights will be converted to volume measurement for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Resident Engineer and shall be agreed to by the Contractor before such method of measurement of pay quantities will be accepted.

D. Measurement by Area: Measurement by area will be by the square dimension shown on the Contract Drawings or as specified. Method of square measurement will be as specified.

E. Linear Measurement: Linear measurement will be by the linear dimension listed or indicated in the Contract Price Schedule. Unless otherwise indicated, items, components, or Work to be measured on a linear basis will be measured at the centerline of the item in place.

F. Field Measurement for Payment:

1. The Contractor shall take all measurements by providing equipment, workers, and survey crews as required to measure quantities in accordance with the provisions for measurement specified herein. Unless otherwise specified, all

quantities shall be calculated using dimensions shown on the Contract Drawings. No allowance will be made for specified tolerances.

2. The Resident Engineer will verify all quantities of Work performed by the Contractor on a unit-price basis, for progress payment purposes.

1.06 REJECTED, EXCESS, OR WASTED MATERIALS

Quantities of material wasted or disposed of in a manner not called for under the Contract; rejected loads of material, including material rejected after it has been placed by reasons of the failure of the Contractor to conform to the provisions of the Contract; material not unloaded from the transporting vehicle; material placed outside the lines indicated on the Contract Drawings or established by the Resident Engineer; or material remaining on hand after completion of the Work, will not be paid for, and such quantities shall not be included in the final total quantities. No additional compensation will be permitted for loading, hauling, and disposing of rejected material.

1.07 ITEM MEASUREMENT AND PAYMENT

The items listed on the Contract Price Schedule will be measured and paid for as described in Appendix A to this Specification Section. Payment will only be made for work that has been satisfactorily completed. Items not listed in the Contract Price Schedule but considered necessary to complete the Work, will be considered incidental to the Work, and no separate measurement and payment will be made.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

APPENDIX

Appendix A: Contract Pay Item – Measurement and Payment Provisions

CONTRACT SPECIFICATIONS

SECTION 01 20 00.20

PRICE AND PAYMENT PROCEDURES - DESIGN-BID-BUILD CONTRACTS

APPENDIX A – CONTRACT PAY ITEM - MEASUREMENT AND PAYMENT PROVISIONS

Item #1: All Work of this Contract, excluding Items 2 through 4.

- a. Item Description: The Work of this item includes all work required by the Contract Documents excluding the work required for Items #2 through # 4.
- b. Measurement: This item will be measured as a lump sum unit.
- c. Payment: This item will be paid for at the Contract lump sum price, as specified in the Contract Price Schedule.

Item #2: Provisional Sum for Differing Site Conditions

- a. Item Description: The Work of this item includes any differing site conditions.
- b. Measurement: No separate measurement will be made for this item.
- c. Payment: This item will be paid for in accordance with the General Conditions for Payment on Time and Material Basis for work satisfactorily completed and approved by the Resident Engineer.

Item #3: Provisional Sum for Additional Community Construction Impact Mitigation.

- a. Item Description: The Work of this item includes providing additional community construction impact mitigation not otherwise specified in the Contract as directed by the Resident Engineer.
- b. Measurement: No separate measurement will be made for this item.
- c. Payment: This item will be paid for in accordance with the General Conditions for Payment on Time and Material Basis for work satisfactorily completed and approved by the Resident Engineer.

Item #4: Provisional Sum for Reimbursement of Change Notice Work Directives.

- a. This item is to reimburse the contractor for Work performed as a result of Change Notice Work Directive(s) (CNWD), until such time as the CNWD is converted to a Change Order.
- b. Measurement: No separate measurement will be made for this item. The costs reimbursable under this item include the costs associated with eligible work directives as directed by the Resident Engineer.
- c. This item will be paid for in accordance with General Provision 9.09 for Payment on Time and Material Basis for work approved by the Resident Engineer.

END OF APPENDIX

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for requesting substitutions for materials, equipment, or processes for which the Contract does not explicitly allow an "approved equal."
- B. Items which are being submitted under the "approved equal" provision of a specification shall be submitted under the specification section in which an "approved equal" is explicitly allowed and not under this specification section.

1.02 SUBMITTALS

Request for Substitution (Exhibit A).

1.03 QUALITY ASSURANCE

- A. Investigate and document compatibility and performance of the proposed substitution with the Contract required item, process or performance requirement. Where applicable, engage a qualified Independent Testing Laboratory to conduct and document tests demonstrating compatibility, reliability and/or performance.
- B. Coordination: Upon approval, modify or adjust affected work as necessary to integrate the substitution.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Submit each request for consideration on a separate Request for Substitution form.
- B. Submit a Request for Substitution under this Section 01 25 00, Substitution Procedures and not under the technical specification section containing the originally specified item. Upon Sound Transit's approval of the substitution request, submit product data under the technical specification section of the originally specified item.
- C. Supplement the Request for Substitution Form (Exhibit A) with the following documentation in addition to the requirements stated on the form.
 - 1. Statement indicating reason specified product or fabrication or installation or process cannot be provided, if applicable

2. Description of the differences between the proposed substitution and the specified item.
 3. If this substitution has an effect on other work or the functionality of an assembly or system, provide information, certifications, or test data demonstrating compatibility and coordination requirements, including a list of changes or modifications needed for other parts of the Work or for work performed by other Sound Transit contractors that will be necessary to accommodate the proposed substitution.
 4. Contractor's Request for Change with appropriate credit corresponding to the requested substitution
 5. 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, sustainable design characteristics, warranties, and/or other specific features and requirements indicated in the requirements document.
 6. Include annotated copy of all applicable Contract requirements and drawings. Indicate deviations, if any, from the Work specified.
 7. Product data, shop drawings, descriptions of products and installation procedures.
 8. Samples, where applicable.
 9. Certificates and qualification data, where applicable
 10. List of similar installations for completed projects with project location and names, and architects, engineers and owners contact information.
 11. Material test reports from a qualified Independent Testing Laboratory indicating and interpreting test results for compliance with Contract requirements.
 12. Detailed analysis based on the Contractor's Construction Schedule(s) demonstrating the effect of the proposed substitution(s) on the Contract Milestones. If availability of the specified item or equipment impacts a Contract Milestone, include a letter from manufacturer or supplier, on its letterhead, stating the original date of the purchase order, reasons for the lack of availability or delays in delivery, and normal lead-time.
 13. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as may be indicated in substitution request, is compatible with related materials and is appropriate for application.
- D. Submit complete information on changes to Contract Documents that the proposed product substitution will require for its proper installation

END OF SECTION

EXHIBITS

Exhibit A: Request for Substitution Form



EXHIBIT A
SECTION 01 25 00
REQUEST FOR SUBSTITUTION

1. Date of Request:	2. Tracking Number:
3. Specification Section(s):	
4. Specified Requirement to be Substituted:	
5. Proposed Substitution:	
6. Explanation for Substitution (attach documentation as required in 01 25 00):	

Does the substitution affect requirements on the Contract Documents?
☐ Yes ☐ No

Manufacturer's guarantees of the proposed and specified items are:
☐ Same ☐ Different (provide explanation) ☐ N/A



EXHIBIT A
SECTION 01 25 00
REQUEST FOR SUBSTITUTION

7. The undersigned states that the function, appearance, constructability, interfaces with other contracts and quality of the proposed items are equivalent or superior to the specified requirement.

Signature

Print Name, Title, and Company

Date

8. DOR Concurrence:

☐ Accepted ☐ Accepted as Noted

The undersigned concurs the substitution will have no direct or indirect impact on fit, function, reliability, maintainability, operability, or interfaces with other contracts and/or systems safety aspect of the work product.

Notes:

OR ☐ Rejected

Explanation of Rejection:

Signature

Print Name, Title, and Company

Date

9. Corridor Design Manager Evaluation*:

The undersigned confirms the substitution will have no direct or indirect impact on fit, function, reliability, maintainability, operability, quality, constructability or interfaces with other contracts and/or systems safety aspect of the work product, and has consulted with the appropriate ST Subject Matter Experts.

Substitutions which have a direct or indirect impact on fit, function, reliability, maintainability, operability, quality, constructability or interfaces with other contracts and/or systems safety aspect of the work product shall be evaluated by the Material Review Board (MRB) for acceptance.

☐ Accepted ☐ Accepted as Noted ☐ Rejected ☐ MRB Evaluation Required

Notes:

Signature

Print Name and Title

Date

*Delegation of evaluation authority shall be confirmed with Design and Engineering and documented in the Project Management Plan.



10. Agency Quality Assurance Review

☐ Approved for process

Signature

Print Name and Title

Date

11. MRB Evaluation (if required):

☐ Accepted ☐ Accepted as Noted ☐ Rejected ☐ N/A

Explanation if Rejected:

Signature

Print Name (MRB Chair)

Notes:

END OF EXHIBIT

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.01 SUMMARY

This Section identifies some of the Project meetings that will occur on or after Notice to Proceed and during construction, and the recording of meeting minutes.

1.02 PRECONSTRUCTION MEETING

- A. A preconstruction meeting will be scheduled and conducted by Sound Transit on or within 7 days after the date of the Notice to Proceed. Attendance is required by the Contractor project manager, superintendent and other necessary personnel. Sound Transit will introduce its representatives, key project stakeholders, governmental agencies and public and private Utilities. Sound Transit will provide Notice of this meeting not less than 7 days prior to the date of the meeting.
- B. At this meeting, Sound Transit will discuss:
 - 1. Administrative
 - a. Responsibilities and authorities of the Resident Engineer
 - b. Selected laws, codes, traffic regulations and permit requirements of public agencies and their regulations
 - c. Labor requirements and certified payroll. Equal Employment Opportunity (EEO), Small Business and Disadvantaged Business Enterprises (SBE and DBE) and apprenticeship program requirements
 - d. Major Small Business and Disadvantaged Business Enterprises (SBE and DBE) Subcontractors and their areas of responsibility
 - e. Special Conditions
 - f. Community relations functions
 - g. Partnering
 - 2. Construction quality control requirements, plan and procedures
 - 3. Safety
 - a. Safety Certification process requirements
 - b. Contractor safety and accident prevention program
 - c. Requirements for safety, first aid, emergency actions, security and full-time safety representatives and public safety measures
 - d. Risk management
 - 4. Cost
 - a. Breakdown of schedule of values lump sum items
 - b. Monthly progress payments
 - c. Payment for materials, stored materials and equipment on hand

- d. Final quantities and final payment
- 5. Schedule
 - a. Project schedule including critical path activities
 - b. Three-week look-ahead schedule
- 6. Meetings
 - a. Construction Progress meetings
 - b. Quality Control meetings
 - c. Schedule meetings
 - d. Progress payment meetings
 - e. Change Order meetings
 - f. Construction Work Plan Readiness Review meetings
 - g. Commissioning meetings, if applicable to this Contract
 - h. Coordinated Installation Program (CIP) meetings, if applicable to this Contract
 - i. Instrumentation Coordination and Data Review meetings, if applicable to this Contract
 - j. Dewatering Coordination and Data Review meetings, if applicable to this Contract
 - k. Construction Coordination meetings, if applicable to this Contract
- 7. Work Scope
 - a. Use of office, streets, rights-of-way, haul routes, storage areas, staging areas, construction areas and temporary easements, and the housekeeping requirements thereof
 - b. Construction means and methods
 - c. Anticipated means and methods for worksite layout, erosion and sedimentation control plans, haul routes, noise abatement, vibration monitoring, air and water pollution control, excavation support systems, grading, paving, fencing, site drainage and street restoration
 - d. Coordination and notifications required for Utility work and services
 - e. Mobilization, process of early deliverables and submittals, deliveries and priorities of major equipment
 - f. Document control and management systems requirements
 - g. Procedures for processing Change Notices (CNs), Change Orders (COs), correspondence, Requests for Information (RFIs), shop drawings, Submittals, product data and Samples
 - h. Completion of Work and Contract close out
- 8. Other, if applicable to this Contract, including but not limited to:
 - a. Sustainability program

- b. Art projects
- c. Sound Transit-furnished materials and equipment

1.03 CONSTRUCTION PROGRESS MEETINGS

- A. Construction progress meetings will be scheduled and conducted by the Resident Engineer and held each week during the period of performance of the Contract.
- B. Special meetings will be scheduled and conducted by Sound Transit throughout the course of construction as Sound Transit deems necessary. The Resident Engineer may call special meetings to review pay application, discuss and negotiate Change Order requests, coordinate the Work, answer questions and resolve problems.
- C. The Contractor's relations with its Subcontractors and Suppliers, and discussions relative thereto, and the Contractor's responsibility as described elsewhere in the Contract Documents are not part of Construction Progress meeting content. Should it be necessary to address the relationships and responsibilities described elsewhere in the Contract Document, a separate meeting will be held with select individuals from the Contractor, the Resident Engineering team and Sound Transit, as appropriate to the subject matter.
- D. Attendance will include the Resident Engineer, architect and consultants (as needed), Contractor's project manager and superintendent, major Subcontractors and others as appropriate.
- E. The agenda will generally include the following:
 - 1. Construction safety and report on safety incidents and safety statistics.
 - 2. Community outreach
 - 3. SBE/DBE Utilization and Apprenticeship Program issues
 - 4. Schedule review and projection of work including Contractor's presentation of Contractor's updated three week look-ahead schedule covering the current week and the 2 weeks immediately following. Review critical path activities and corrective measures to maintain progress, if behind schedule.
 - 5. Review previous period look-ahead schedule showing activities accomplished and not completed and discuss the reasons for postponed activities.
 - 6. Outstanding action items, structural, mechanical, electrical, architectural, civil, environmental mitigation, technical concerns, submittals, fabrication, procurement, requests for information and as-built review
 - 7. Quality observations, audit or surveillance reports, failed tests, non-conformances and employee work standards.
 - 8. Coordination of Utility work and Utility strikes
 - 9. Discuss changed or unforeseen conditions, requests for proposals, Change Order requests, time extensions and other relevant subjects as they affect the progress of the Work.
 - 10. Discuss Temporary Erosion and Sedimentation Control open items found on field inspection report and Contract permit compliance.
 - 11. Discuss commissioning work progress and coordination.

1.04 QUALITY CONTROL MEETINGS

As specified elsewhere in the Contract documents.

1.05 PROGRESS PAYMENT MEETINGS

As specified elsewhere in the Contract documents.

1.06 CHANGE ORDER MEETINGS

Meet every 2 weeks at a minimum or more frequently as necessary, with the Resident Engineer to discuss status and negotiate Change Orders.

1.07 CONSTRUCTION WORK PLAN READINESS REVIEW MEETINGS

As specified elsewhere in the Contract documents.

1.08 COMMISSIONING MEETINGS

As specified elsewhere in the Contract documents.

1.09 INSTRUMENTATION COORDINATION AND DATA REVIEW MEETINGS

As specified elsewhere in the Contract documents.

1.10 DEWATERING COORDINATION AND DATA REVIEW MEETINGS

As specified elsewhere in the Contract documents.

1.11 CONSTRUCTION COORDINATION MEETINGS WITH FOLLOW-ON CONTRACTORS

As specified elsewhere in the Contract documents.

1.12 AUTHORITY TO COMMIT

Individuals designated by the Contractor to attend and participate in Project meetings shall have all required authority to commit the Contractor to solutions as agreed upon in the meetings.

1.13 MINUTES

- A. The Resident Engineer will compile minutes (unless otherwise arranged/agreed) of each Project meeting and will distribute copies to all interested parties. Minutes will be prepared in action-item format with named responsible parties and dates for completion indicated for each item.
- B. The minutes compiled by the Resident Engineer will be the record minutes and all clarifications and corrections shall be transmitted in writing to the Resident Engineer within 3 days of date of receipt of the minutes or noted during the next scheduled meeting under the appropriate agenda item, whichever is sooner. Transmitted corrections shall be legibly submitted on company letterhead.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 25.10

DOCUMENT CONTROL AND INTERNET-BASED DOCUMENT MANAGEMENT SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for document control and records management, and the use of an Internet-based document management system (IBDMS) software required for Contract communications and collaboration by the Contractor with Sound Transit.

1.02 REFERENCES

A. Definitions

1. Electronic Documents Written and/or graphic documents produced or converted to electronic files using computer software; Capable of being stored and retrieved:
 - a. From an electronic storage device,
 - b. Through a collaboration system over the Internet,
 - c. Through an electronic system such as email or
 - d. From a CD, DVD or other portable device.
2. Notice Date:
 - a. The date captured in the metadata of the IBDMS (the "created" date) once a document has been uploaded and checked in.
 - b. The receipt date of a hard copy document that is not submitted in electronic format via the IBDMS.
 - c. All documents submitted to Sound Transit through the IBDMS after 3:00 PM will be acknowledged no earlier than the next business day.
3. The IBDMS: Microsoft SharePoint utilized by Sound Transit:
 - a. Handles document management, collaboration, classification, storage and retention.
 - b. Provides secure, permissions-based access which requires identification of all users and their corresponding permission levels.
4. Document Control Desktop Instructions: Sound Transit's Document Control Desktop Instructions for Construction Contractors using a SharePoint Collaboration Portal.

1.04 SUBMITTALS

A. Transmittals:

1. The Contractor's authorized representative is the Contractor's project manager or designee. Submit the name of Contractor authorized representative responsible to send and receive correspondence: Within 14 days of issuance of the Notice to Proceed (NTP).
2. User Identification Information: For each proposed authorized IBDMS user, provide the following information:
 - a. Full Name and company affiliation.
 - b. Work phone number and work email address.
 - c. Specific job-related function.
 - d. Permission level of access requested; Read Only or Read-Update which requires Sound Transit provided training.
3. Request initial user authorizations within 14 days of NTP. Request additional user authorizations as needed to perform the work.
4. Request to Rescind User Access: As soon as possible but not exceeding 30 days of when a user leaves the Project or should no longer have access.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SOUND TRANSIT RESPONSIBILITY

- A. Provide "Contractor Document Control Desktop Instructions".
- B. Provide IBDMS training for each new user authorized with Read-Update access or as requested.
- C. Provide authorized users access to the IBDMS system for the duration of the Contract.
- D. Manage permissions for all IBDMS users.
- E. Provide technical support (administration) for the IBDMS through Sound Transit Document Control & Configuration group and Sound Transit Information Technology group. The IBDMS System vendor will act solely through and at the request of Sound Transit.
- F. Track history of revisions and activities for documents submitted or managed within the IBDMS, as appropriate.
- G. Sound Transit Document Control will provide guidance as needed if there is disagreement between consultant Field Office Document Control and Contractor during interpretation of the requirements of this specification or Contractor Document Control Desktop Instructions.

3.02 DOCUMENT MANAGEMENT SYSTEM REQUIREMENTS

- A. Provide computer software, hardware, security, and internet access that meets the requirements of the IBDMS, Contractor Document Control Desktop Instructions, and Sound Transit's Information and Design Technology groups, at both field and home office location(s) where documents are generated or processed. Any non-specified software

used by the contractor must meet Sound Transit's requirements and approval. General requirements are as follows:

1. A browser (Chrome or equivalent) with the version being kept up to date in accordance within the support requirements of the manufacturer and is compatible with Sound Transit's IBDMS system.
2. Core set of Microsoft Office 365 Collaboration Tools.
3. Document-Capture Software: Including Optical Character Recognition (OCR) and Virtual Rescan (VRS) for automated image cleanup capabilities, (Such as Adobe) with the version being kept up to date in accordance within the support requirements of the manufacturer.
 - a. Portable Document Format (PDF): Adobe Standard, Bluebeam.
4. A scanning device with OCR capabilities capable of scanning a minimum of 11-inch by 17-inch color document into electronic PDF with a minimum density of 300 dpi
5. Broadband connection using Integrated Services Digital Network (ISDN), Digital Subscriber Line (DSL) or better.

3.03 INTERNET-BASED DOCUMENT MANAGEMENT SYSTEM (IBDMS)

A. Training

1. It is mandatory that each authorized IBDMS user with Read-Update access attend document control training provided by Sound Transit.

B. IBDMS Access Requirements

1. Maintain a current list of authorized users of the IBDMS and provide to Resident Engineer as requested.
2. Protect the security of the IBDMS system by limiting access to authorized users only. Take appropriate precautions to maintain the security of the system. Immediately notify the Resident Engineer of all changes to the list of authorized users.
3. Access will be provided in accordance with permission levels configured by the IBDMS administrator. Resident Engineer reserves the right to deny any user access to the IBDMS.

C. IBDMS Use Requirements

1. Follow the requirements outlined in the "Contractor Document Control Desktop Instructions" and Sound Transit document control training.
2. Comply with applicable laws, regulations, and Sound Transit document control and engineering procedures regarding electronic transmission of documents requiring professional engineering stamps or signatures (wet ink or electronic), including provision of hard copies of such documents, as appropriate.
3. Use of the IBDMS shall not relieve the Contractor of the obligation to provide Sound Transit or Authorities Having Jurisdiction with hard copies as required or specified.

4. In the event the IBDMS system is temporarily unavailable or not functional, notify the Resident Engineer by email. Continue transmitting documents utilizing other electronic means or hard copies. Maintain all records and upload them to the IBDMS once the IBDMS becomes available.

3.04 IMPLEMENTATION OF DOCUMENT CONTROL

A. Document Control

1. Do not change or alter Contract records or documents without Resident Engineer's written approval.
2. Maintenance of paper-based document communications shall meet the requirements outlined in Sound Transit's "Contractor Document Control Desktop Instructions".
3. Establish correspondence routing, filing, classification, control and retrieval methods, which are compatible with the IBDMS, for all project records.
4. Provide access to current revisions of procedures, instructions, Contract Drawings, Contract Specifications and other documents to personnel, Subcontractors and Suppliers on a timely basis.
5. Ensure that all parties are working from current documents.
6. Protect records and documents from damage and loss and maintain backup records.
 - a. Store required hard copy records in secure cabinets at the Site and maintain a duplicate set at another location. The off-site duplicate set may be an electronic image format (i.e. PDF).
 - b. Store backup electronic records not saved to the Sound Transit IBDMS site. Back up electronic records daily. Store electronic record backup(s) off-site at a secure location. Backup storage may be accomplished using a variety of media, including external storage such as DVDs and external hard drives, or on a secure, off-site server. Store in an environment with appropriate temperature and humidity controls for the storage method and media.
 - c. Ensure equipment and software capable of storing, reading and reproducing the stored electronic records are available in the event of a disaster or failed disaster.

B. Document Preparation and Submission

1. Address all Contract correspondence from the Contractor's Project Manager to the Resident Engineer. Delegate in writing, the individual responsible for issuance of Contractor correspondence when the Contractor's Project Manager is not available.
2. Each correspondence package must be submitted as a stand-alone item. Example: A Request for Information (RFI) and a Submittal shall not be submitted in the same package.
3. Address only one subject in each letter, submittal or transmittal or other document addressed to Sound Transit. Clearly identify the subject on the document.

4. Follow requirements provided in Sound Transit's document control training, the "Contractor Document Control Desktop Instructions", and clarifications given by Sound Transit Document Control and Configuration staff, including standard naming and numbering conventions.

C. Electronic Documents

1. Submit and process all documents using the IBDMS. For any documents that have physical characteristics that cannot be uploaded or are not to be uploaded into the IBDMS in accordance with this Section, upload the transmittal for these documents and deliver hard copies with a hard copy of the transmittal to Sound Transit. Written documents not processed and submitted in accordance with this Section will not be recognized.
2. Do not submit documents which contain private information (such as a taxpayer identification number, a financial account number, an individual's social security number or birth date, or the name of person known to be a minor) via the IBDMS or email. Submit in hard copy only or submit an electronic file with the private information redacted.
3. Scanned documents that include a CD/DVD or other electronic media shall be submitted via hard copy transmittal. The electronic media shall be labelled in accordance with the applicable naming and numbering convention as shown in the "Contractor Document Control Desktop Instructions".
4. Scanned documents that include a physical sample shall be submitted via hard copy transmittal. The physical sample shall be labelled with the Contractor's correspondence number and other information identified in the applicable naming and numbering convention in accordance with the "Contractor Document Control Desktop Instructions". The scanned document will include the transmitting document and a picture of the physical sample.
5. Ensure scanned documents include all intended content, with proper content rotation.
6. Submit documents in PDF format as a single file, unless there is a specific requirement to provide a document in its original format (example: Construction Schedule(s) in native file format) or if the single file size is too large to upload to the IBDMS.
7. In instances where a record is required in native file format, upload the native file to the IBDMS as a separate record from the PDF containing the full submittal. In instances where multiple files are required due to the file size, upload each of the files to the IBDMS as a separate record in PDF format following naming conventions in the "Contractor Document Control Desktop Instructions".
8. Electronic files shall not contain embedded links, portfolios, EXE files, or attached files or documents of any file type.
9. Do not upload ZIP files except for electronic files in CAD format.
10. Do not apply password protection on any electronic document. This applies to any file, whether Sound Transit is the intended recipient or not. This includes any electronic document created or uploaded within the IBDMS system, email, or stored by the Contractor as part of the Project records.
11. When possible, convert documents directly from the original format to PDF.

12. Email shall not be used for formal, official communication with Sound Transit and its representatives. Use of email does not waive the requirement to submit documentation through the IBDMS and/or in hard copy and does not meet the requirement for contractual Notice.
13. The subject line for all emails sent to Sound Transit shall begin with the Contract Unit Description, following the standard naming convention in the subject line in accordance with "Contractor Document Control Desktop Instructions" (e.g. E130).

D. Hard Copy Documents

1. Hard copies are required for, but not limited to, the following documents:
 - a. Any documents and correspondence that contain original wet signatures, engineering stamp or seal, etc., in accordance with the ST Document Control Desktop Instructions.
 - b. Operations and Maintenance Manuals
 - c. Training Materials
 - d. Transmittal and Submittal of physical samples, electronic media and other physical items required
 - e. Other hard copy documents identified in the ST Document Control Desktop Instructions or Contract.
2. Exceptions to the hard copy requirements may be submitted to Resident Engineer for consideration and subject to Sound Transit Document Control approval.

3.05 AUDITS

- A. Sound Transit may periodically audit the Contractor's document control system and records in accordance with Sound Transit Document Control requirements.
- B. Respond to audit findings within 10 days of the date of the audit report. Identify root cause of non-conformance with corrective and preventive actions including their corresponding dates.

END OF SECTION

SECTION 01 32 13.25

SCHEDULING OF WORK

DESIGN-BID-BUILD

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for the preparation, revision and submittal of a Contract Critical Path Method (CPM) Schedule and an Earned Value Management System (EVMS).

1.02 DEFINITIONS

- A. Scheduler: The individual or entity assigned by Contractor with the responsibility for the development, preparation and management of all required CPM schedules, the EVMS Plan and submittals.
- B. Recovery Schedule: A schedule showing a Work Plan to complete the Work within the required Contract Milestones.

1.03 SOFTWARE REQUIREMENTS

- A. Use Primavera Project Management P6 Release 8.2 or later version by Oracle or Microsoft Project 2010 or later version scheduling software.

1.04 SUBMITTALS

- A. Preliminary Baseline CPM Schedule: Submit within 14 days after Notice to Proceed (or Limited NTP).
- B. Contract Baseline CPM Schedule and EVMS Plan: Submit within 30 days after Notice to Proceed or Limited NTP, if a Limited NTP is issued.
- C. Monthly Update CPM Schedule: Submit no later than the 5th of each month.
- D. Three-Week Look-Ahead Schedule: Provide at progress meetings or transmit by the Wednesday of weeks without progress meetings.
- E. Monthly Update Progress Report and Earned Value (EV) Report: Submit no later than the 5th of each month
- F. Scheduler Qualification: Submit documentation within 14 days of NTP.

1.05 QUALITY ASSURANCE

- A. Qualifications: Designate a Scheduler who will be responsible for the development, preparation and management of all required CPM schedules and EV Systems. The designated Scheduler(s) shall have at least 5 years of experience developing, creating, managing and reporting on schedules of similar size and complexity to this Contract and experience in the designated scheduling software system.

1.06 GENERAL

- A. Submittal Formats

1. Electronic Copy:
 - a. Preliminary and Contract Baseline CPM Schedule: Electronic backup file in its native form (.XER, .MPP) and in .PDF format.
 - b. Contract Earned Value Management System: Electronic backup file in its native form .XLS and in .PDF format.
 - c. Monthly Update CPM Schedule: Electronic backup file in its native form (.XER, .MPP) and in .PDF format.
 - d. Monthly Update Progress Report: Electronic file in .PDF format.
 - e. Monthly Earned Value Report: Electronic backup file in its native form .XLS and in .PDF format.
- B. Within 14 days after NTP (or LNTP, if one is issued), the Contractor shall schedule with the Resident Engineer and attend a pre-scheduling and EVM conference with Sound Transit to review and discuss the Preliminary Baseline CPM schedule, the EVMS Plan and the requirements of this Section. The Contractor shall be prepared to discuss methodology for the schedule development, and sequence of operations.
- C. Schedules shall represent a practical and logical plan to complete the Work within the Contract Milestones and to convey the plan for execution of the Work.
- D. The submittal of schedules shall be understood to be the Contractor's representation that the schedule meets the requirements of the Contract Documents and that the Work will be executed in the sequence and duration indicated in the schedule.
- E. Failure to include any element of Work required for performance of the Contract or failure to properly sequence the Work shall not excuse completing all Work with the Contract Milestones.
- F. All schedule submittals, excluding monthly progress reports, are subject to Sound Transit acceptance.
- G. The Contract Baseline CPM Schedule will not be accepted prior to acceptance of the Schedule of Values.
- H. Use the "Retained Logic" of Primavera P6 or comparable preference for scheduling activities.
- I. Develop all schedules utilizing industry standard 'best practices' including, but not limited to:
 1. All Activities shall have at least one predecessor and one successor, except Project start and finish milestones.
 2. All Activities must have a finish successor (FF) or (FS)
 3. All Activities must have a start predecessor (SS) or (FS)
 4. Maintain a majority of Finish to Start Relationships
 5. One discipline per activity
 6. No use of constraints other than those defined in the Contract Documents without the prior acceptance by Sound Transit.
 7. Leads or lags shall not be used.

8. Use a "Finish on or Before" constraint for all Contract milestones unless agreed to by Sound Transit.
- J. Ensure that all individual construction activities do not exceed 14 days in duration without prior approval of Sound Transit. Subdivide activities exceeding 14 days in duration to an appropriate level of detail.
- K. Subdivide all major concrete activities, as a minimum, into formwork, reinforcement bar placement, placing of embedment, concrete placement and finish, and curing periods, unless agreed to by the Resident Engineer.
- L. Sufficiently describe schedule activities to include that which is to be accomplished in each Work area. Express activity durations in whole days. Clearly identify Work that is to be performed by Subcontractors.
- M. Create all schedules in conformance with the work-hours, constraints and Activity Code Structure as set forth in the Contract.
- N. Project Calendars
 1. Work calendars shall adhere to Contract Specifications.
 2. Each activity in the schedule shall adhere to a calendar appropriate for the Work type
- O. WBS Structure: Project WBS Structure shall provide at a minimum the following:
 1. Construction
 - a. Milestones
 - b. Submittals/Preliminary Activities
 - c. Mobilization
 - d. Site work
 - e. Excavation
 - f. Retaining Walls
 - g. Aerial Structures
 - h. Stations
 - i. Parking Garages
 - j. Trackwork
 - k. Finishes
 - l. Landscaping/Flatwork
 - m. Testing and Commissioning
 - n. Demobilization
 2. Provisional Sums

3. Change Orders
4. Deleted Activities

1.07 PRELIMINARY BASELINE CPM SCHEDULE

- A. CPM Schedule: Covering the complete Contract Work.
 1. The purpose of the Preliminary Baseline CPM schedule is to depict the detailed Work activities for the first 90 days following Notice to Proceed (NTP) (or Limited NTP (LNTP)). Subsequent activities can be in more summary-level detail. The schedule will assist and serve as the basis of payment between NTP (LNTP) and the acceptance of the Contract Baseline CPM Schedule.
 2. Include with the Submittal a written narrative that describes the schedule in detail and the approach to the Work.
 3. Include all Submittal, fabrication and construction activities required to supply or progress the Work for the first 90 days following Notice to Proceed (NTP) (or Limited NTP (LNTP)).
 4. Indicate on the schedule diagram a clearly defined Critical Path.
 5. If, the schedule is determined to be insufficient or not in compliance with the Contract Documents, revise the schedule and resubmit within 7 days.

1.08 CONTRACT BASELINE CPM SCHEDULE AND EVMS PLAN

- A. Contract Baseline CPM Schedule: Covering all Work of the Contract through Acceptance.
- B. Prior to submitting the Contract Baseline CPM Schedule, the Contractor will schedule with the Resident Engineer and attend a scheduling conference with Sound Transit to present the Contract Baseline CPM Schedule and discuss its contents including schedule assumptions, schedule risk, production rates, project calendars, shift assumptions, equipment constraints, material procurement concerns, long-lead materials and equipment, risk assumptions EVMS Plan and Critical Path(s).
- C. If, the schedule or EVMS Plan is determined to be insufficient or not in compliance with the Contract Documents, revise the schedule and resubmit within 7 days.
- D. Show clearly on the Contract Baseline CPM Schedule the sequence and interdependence of activities and list specifically:
 1. All constraints identified in the Contract Documents
 2. All Milestones identified in the Contract Documents. Ensure that they are logically linked with physical activities and are progress driven.
 3. Include all submittal, fabrication and construction activities required to supply and / or progress the Work for the duration of the Contract.
 4. Selection, ordering, manufacturing, factory testing and delivery of all long-lead equipment and materials.
 5. Delivery of Sound Transit-furnished equipment and / or materials, if any
 6. Inspection of the Work activities for Substantial Completion and Acceptance
 7. Work to be performed by other agencies or utilities that affect the schedule shall include at a minimum activity durations and completion milestones for utility's or

other agency's work and shall show when the utility's or other agency's work must be complete to avoid impact to Contractor's work.:

8. Acquisition of construction permits
- E. Indicate on the schedule diagram a clearly defined Critical Path.
- F. Certify in writing that the Contract Baseline CPM schedules have been discussed in detail with all Subcontractors and major Suppliers as it relates to their respective Work. Include signatures from the major Subcontractors acknowledging that such discussions were conducted with them. Transmit a copy of the certificate with Subcontractor acknowledgements to Sound Transit.
- G. Include with the Contract Baseline CPM Schedule submittal a detailed written narrative describing the approach and methods for completion of the Work. Include all schedule assumptions used in the development of the schedule including but not limited to the following: shift assumptions, crew size, project calendars, duration development, Critical Path(s), production rates, long lead material and equipment procurement and specific identified schedule risks. Use understandable narrative language to convey this schedule information to Sound Transit.
- H. A Contract Baseline CPM Schedule showing the Work completed in less than the Contract Milestones, which is found practical by Sound Transit, shall be considered to have Float (in addition to any required Sound Transit-controlled Float). Impractical early-completion schedules will not be accepted by Sound Transit.
- I. The Contract Baseline CPM Schedule shall be submitted without progress updates to schedule dates and costs.
- J. EVMS Plan: Covering the contract Work through Acceptance
 1. Submit a Contract Earned Value Management System Plan covering the Contract Work through Acceptance which includes a documented plan for implementing, updating and reporting using the EVMS including how to process approved changes to the scope, schedule and budget.

1.09 MONTHLY UPDATE CPM SCHEDULE

- A. Submit a cost-loaded Monthly Update CPM Schedule with each application for payment
- B. Include in the Monthly Update CPM Schedule a data date (status) as of the first day of the following month (for example: for schedules submitted at the end of January 20xx, the data date shall be 01 February 20xx).
- C. Incorporate into the Monthly Update CPM Schedule all progress to date, changes to the planned sequence including logic revisions, and changes to activity durations as required. Sum all the remaining activities to be completed to the remaining cost of the Work.
- D. Incorporate accurate, actual progress, start dates, completion dates and costs so that the Monthly CPM Schedule will act as the Contract's As-Built schedule.
 1. If requested, provide documentation to substantiate as-built information.
 2. No actual start or finish dates shall be changed or corrected without a narrative explaining the reason for the change, and without Sound Transit's acceptance.
- E. Address all changes and revisions made in the Monthly Update CPM Schedule in a detailed narrative accompanying the submittal.

- F. Incorporate Change Orders and Change Notice-Work Directives (CN-WDs) into the Monthly Update CPM Schedule as additional schedule activities, when required.
- G. If the information contained in the Monthly Update CPM Schedule is insufficient and cannot be substantiated otherwise, revise the schedule accordingly and resubmit within 7 days.
- H. Submit a Recovery Schedule prior to the next progress payment if, according to the current updated Monthly Update CPM Schedule, the Work is more than 14 days behind a Contract Milestone, considering all granted or agreed to time extensions. Include with the submittal a detailed narrative describing the means and methods proposed to complete the Work in the prescribed period.

1.10 THREE-WEEK LOOK-AHEAD SCHEDULE

- A. Transmit the Three-Week Look-Ahead Schedule, in a Gantt chart format, showing the intended Work activities for the upcoming 3-week period plus one retrospective week.
- B. All construction activities in the Three-Week Look-Ahead Schedule must correlate to an activity in the current Monthly Update CPM Schedule either as a one-to-one match or as a subset of activities whose cumulative duration correlates to an activity in the Monthly Update CPM Schedule.
- C. Portray all activities clearly and legibly on the schedule and include activity numbers from the current approved Preliminary, Contract or Monthly Update CPM Schedule.

1.11 MONTHLY UPDATE PROGRESS REPORT AND EARNED VALUE REPORT

- A. Include with the Monthly Update CPM Schedule a written narrative describing the approach and methods for completion of the Work. Use understandable narrative language that conveys schedule information to Sound Transit.
- B. Include with the Monthly Update CPM Schedule submittal a written narrative describing:
 - 1. Executive Summary
 - 2. Contract Status (percent complete based on cost and percent of contract time elapsed)
 - 3. Schedule Status (baseline versus current forecast) for each Milestone
 - 4. Work activities accomplished in the reporting period
 - 5. Intended Work activities for upcoming reporting period
 - 6. Community Relations Activities, accomplished in the reporting period and intended in the upcoming reporting period.
 - 7. All changes, additions or deletions that have been made to the schedule since the prior month and with the exception of adding actual durations, a reason for each of the changes.
 - 8. A listing of all activities that were planned on being completed or worked on during the reporting period but were not and the reason for the lack of activity or inability to complete as scheduled. Discuss the actions taken or to be taken that have addressed adverse impacts to the Contract.
 - 9. Discussion and identification of changes, RFIs, CN-WDs or other events that affect the Contract schedule.
 - 10. Describe and discuss the Critical Path(s)

11. Maintain and provide a computer-generated Earned Value Report (EVR). The template will be provided by Sound Transit. Submit a Monthly EVR with each application for payment or Monthly Update Progress Report

- a. Earned Value Reporting will include:

- 1) Identification of cost and schedule variance.
- 2) Discussion of performance trends through analysis of SPI (Schedule Performance Index), CPI (Cost Performance Index), SV (Schedule Variance, CV (Cost Variance) and ETC (Estimate to Completion).
- 3) Identification of variances exceeding 10% (SPI or CPI less than 0.90 or greater than 1.10) with a description of the root cause, impact on the project and recommended or implemented corrective action.
- 4) Identification of potential problem areas that need further explanation or action.
- 5) Analysis of Contract EAC (Estimate at Completion)

- C. Include in all narratives all assumptions that have been made in developing and updating the schedule.

- D. Include in all narratives all major risk items that could potentially have an adverse impact to the schedule and how these risks are to be addressed and mitigated.

1.12 REVIEW, UPDATE AND REVISIONS

- A. Conform re-submittals to the same requirements as the original submittals.

- B. Allow for Sound Transit review with comments according to the following schedule from the date of receipt:

1. Preliminary Baseline CPM Schedule: 7 working days
2. Contract Baseline CPM Schedule and Contract EVMS Plan: 14 working days
3. Monthly Update CPM Schedule, Monthly Earned Value Report and Recovery Schedule: 10 working days
4. Three-Week Look-Ahead Schedule: 2 working days

- C. Make all corrections to the schedule requested by Sound Transit and resubmit the schedule for acceptance. If the Contractor disagrees with Sound Transit's comments, provide a written notice of disagreement within 7 days from the receipt of Sound Transit's comments on the schedule. Disagreement with Sound Transit's comments to the schedule shall be resolved in a meeting held for that purpose, if necessary.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes procedural requirements for digital photographic documentation, including images, video recordings, and web-based photographic documentation.

1.02 SUBMITTALS

- A. Key Plan(s): Submit initial plan(s). Submit updates with each photographic documentation submittal.
- B. General
 - 1. Provide manufacturer and model of each type of camera.
 - 2. Provide copies of photographic documentation on standard digital media, such as files and disks (readable on common Windows-OS and Linux-OS systems).
 - 3. Identify each digital image in accordance with the Photo Naming Convention for Contractor digital photos in document control and internet-based document management system as described elsewhere in the Contract Documents. Label with the following information:
 - a. Name of Contract
 - b. Name of Contractor
 - c. Submittal date, number and description
 - d. Name and address of photographer
 - 4. In addition to submittals required below, provide annually, or as requested by the Resident Engineer, all documentation since the prior annual submittal.
- C. Digital Still Photographs (Still Photos): Submit digital image of each photograph. Submit a colored thumbnail index of photographs with electronic file name of each photo. Provide the following types of still photos:
 - 1. Pre-Construction Photographs: Submit prior to start of construction.
 - 2. Final Complete Construction Photographs: Submit within 14 days of Notice of Acceptance, or prior to occupancy by Owner or another Contractor.
 - 3. Subject-specific construction photographs such as, but not limited to, potential change, non-conformance, quality, and property damage: Submit within three (3) days after photo is taken.
- D. Digital Video Recordings (Video): Submit with an index that includes the following: Identification of each segment by location, time of day, street name, viewing direction, traveling directions, and starting and ending points.

1. Identify each digital image keyed to accompanying key plan.
 - E. Digital Web-Based Photographic Documentation
 1. Web-based photo service provider's name and background
 2. Use multiple files, with consistent file names and consecutive numbers, so that the file sizes do not exceed 3.9 GB.
 - F. Usage Rights Documentation: Obtain and transfer copyright usage rights from photographer and/or videographer to Sound Transit for unlimited reproduction of copyrighted photographic documentation.
 - G. Qualification Data: For videographer and Web-based photographic documentation service provider.
- 1.03 QUALITY ASSURANCE
- A. Videographer Qualifications: An individual who has been regularly engaged in such work on construction projects for not less than three years.
 - B. Web-Based Photographic Documentation Service Provider: A firm specializing in providing photographic equipment, Web-based software and related services for construction projects with a record of providing satisfactory services similar to those required for Project.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Key Plan: Show the layout of the Project Site with notation of vantage points marked for location and direction of each still photo and video recording
- B. All data, image, video and audio, created by cameras and/or microphones, shall be stored on and backed up to different physical media in order to avoid data loss due to equipment failure. Backup data shall be maintained at a different geographical location.

2.02 STILL PHOTOS

- A. Still Photo Camera Specifications:
 1. Minimum sensor resolution: 5 megapixels
 2. Set to produce a digital stamp of the current date and time on each image
 3. Images in JPG format

2.03 VIDEO

- A. Video Camera Specifications
 1. Color digital Video Images: Camera shall be capable of color progressive scan high resolution jpeg digital image output. Camera shall have not less than a C-size lens. Camera output shall use MPEG H.264 data standard.
 2. Resolution and shutter speed: Camera will have a minimum pixel resolution of 4-CIS for the live video stream, and a shutter speed no slower than 1/60 sec.

3. Date and time: Capable of showing a digital stamp on image of current date and current time.

PART 3 - EXECUTION

3.01 GENERAL

- A. Capture all photographic documentation digitally. Submit images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications.
- B. All non-fixed camera documentation shall be done with sufficient lighting to clearly show the subject matter. No documentation shall be done during periods of visible precipitation or when more than 10 percent of the ground area is covered with snow, unless otherwise authorized by the Resident Engineer.

3.02 STILL PHOTO REQUIREMENTS.

- A. Preconstruction Photographs
 1. Provide pre-construction still photos prior to commencement of work at each Site.
 2. Take sufficient overlapping still photos to show existing conditions of Site and adjacent properties before starting the Work.
 3. No construction shall begin prior to Resident Engineer review and approval of the pre-construction photographs of the construction area.
 4. Take still photos at locations to be disturbed or likely to be affected by construction and at locations designated by the Resident Engineer.
- B. Final Completion Construction Photographs:
 1. Take a sufficient quantity of still photos to thoroughly and accurately document the condition of Site Acceptance.
- C. Subject-specific Construction Photographs
 1. If there are any evident changes in conditions, non-conformance in the Work, or signs of potential damage to property or constructed project take sufficient photographs to document the conditions with no less than ten still photos.
 2. Provide a scale to the area/condition, such as a tape measure to substantiate cracking

3.03 VIDEO RECORDING REQUIREMENTS

- A. Audio:
 1. Begin each recording with the current date, Contract name, videographer name, street location, viewing side, and direction of progress.
 2. End recording with date and time.

3. Narration: Describe scenes on video recording by audio narration. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation.
- B. Video:
1. Set to continuously record, transparent digital information (date and time of recording).
- C. Pre-construction and Post-construction Video Recordings:
1. Document the entire Project Site.
 - a. Include all surface features located within at least 300 feet of the construction site and accompany with appropriate audio description. Include all existing curbs, sidewalks, driveways, ditches, paved areas, landscaping, trees, culverts, headwalls, retaining walls, and buildings.
 2. Duration: approximately 120 minutes per alignment
 3. Include time stamp and narrative giving location of the items being shown.

END OF SECTION

APPENDIX

Appendix A: Web-Based Photographic Documentation

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

This Section specifies the general requirements and procedures for preparing and providing construction information including shop drawings, product data, certifications, factory inspection testing, samples, etc.

1.02 DEFINITIONS

- A. Submittal: A Submittal is a document or sample required by the Contract that requires review and response by Sound Transit.
- B. Transmittal: A Transmittal is a document that is required by the Contract to document contract compliance and is provided for information only. Transmittals do not normally require a response by Sound Transit unless Sound Transit identifies a problem with the document or information being transmitted. Transmittals include, but are not limited to: certified payrolls, product certifications, material certifications, welder certification, installer certifications, SBE/DBE utilization reports, pothole or drilling logs, test reports, etc.

1.03 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Prepare and submit each Submittal and Transmittal via the Selected Software as specified elsewhere in the Contract. One hard copy is required for Submittals. One hard copy is required for Transmittals when a wet signature or seal has been applied to the transmittal or its contents.
- B. For scheduling purposes allow 30 days for the initial review of each Submittal, unless noted otherwise, and allow 21 days for review of each resubmission.
- C. The Contractor shall schedule the submission of Submittals (and, if necessary, the resubmission of Submittals) to assure that the Contractor has received from the Resident Engineer, a minimum of 21 days in advance of starting an activity, acceptance of all Submittals required for that activity. Acceptance means the Submittal has received a classification of "No Exceptions Noted" or "Exceptions as Noted – Resubmittal Not Required". The Contractor shall not start work on an activity for which submittals are required until 21 days after acceptance of all associated Submittals for that activity, unless otherwise specifically permitted by the Resident Engineer.
- D. Prepare separate Submittals for each item in a specification Section.
- E. Submittal Naming and Numbering requirements are specified elsewhere in the Contract.
- F. Provide Submittals of related parts of the Work concurrently such that processing will not be delayed for coordination. The Resident Engineer may withhold action on a Submittal requiring coordination until all related Submittals are received.
- G. Place a permanent label or title block on each Submittal item for identification.
 - 1. Include the Contract name and number; the date of submission/re-submission; reference to the applicable Specification Section and paragraph, and / or drawing number; subject matter or drawing detail to which the Submittal applies; and the revision number and date, if applicable.
 - 2. Include the name of firm or entity that prepared each Submittal.

3. Provide a space approximately 2.5 by 2.5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Resident Engineer.
- H. Include on each Submittal and Transmittal, whether from the Contractor or a Subcontractor, an approval stamp signed by the Contractor, indicating that the Submittal/Transmittal has been reviewed and approved by the Contractor, and that the Submittal/Transmittal meets the Contract requirements.
- I. All Submittals/Transmittals shall be submitted with a transmittal form containing the following information:
1. Contract name and number, the date of submission, the name of the Contractor, Subcontractor, Supplier and/or manufacturer, as appropriate, and the document number. The numbering requirements are specified elsewhere in the Contract
 2. Submittal/Transmittal description
 3. Reference to the applicable specification section and paragraph and/or drawing number and title as applicable
 4. Location(s) where product is to be installed, as appropriate
 5. Identification and documentation of any approved deviations from the Contract Drawings and Contract Specifications. Requests for deviations from the Contract Documents must be approved prior to submitting the corresponding Submittal. Requests for Substitution or deviation shall be submitted as specified elsewhere in the Contract and not under the technical specification section containing the originally specified item. Upon Sound Transit's approval of the substitution request, submit product data under the technical specification section of the originally specified item.
 6. Notation that the Submittal is for a Safety Critical Item, if identified on the Sound Transit Specification Conformance Checklist (SCC). The SCC will be provided by Sound Transit.
- J. All Submittals/Transmittals will be provided to Sound Transit directly from the Contractor. The Resident Engineer will discard Submittals received from sources other than the Contractor.

1.04 SUBMITTAL/TRANSMITTAL LOG

- A. A draft electronic version of the Submittal/Transmittal log will be provided by the Resident Engineer after the Contractor has executed and submitted Appendix A: "REQUEST AND RELEASE FOR USE OF SOUND TRANSIT ELECTRONIC SURVEY AND ENGINEERING MEDIA" form.
- B. Provide within 21 days after the effective date of NTP.
- C. Coordinate Submittals with the construction schedule. The log shall reflect the time required for Submittal review, ordering, manufacturing, fabricating and delivery. Include additional time necessary for re-submittals.
- D. The log shall be arranged in a tabular format by Specification Section. The log shall be created and maintained in Microsoft Excel.
- E. The log shall include:
 1. Scheduled date for initial item Submittal, review period and "need" date for

acceptance in order to fabricate, deliver and install within its corresponding construction schedule activity

2. Specification Section number, paragraph number and title
 3. Name of Subcontractor and / or Supplier
 4. Type of Submittal (shop drawings, Product Data, Samples or other), description of the item, name of manufacturer, trade name and model number
 5. Intended submission date
 6. For a Safety Critical Item based on Sound Transit's Specification Conformance Checklist (SCC), include the "Item" number and "Section" (paragraph) number, as shown on the Sound Transit SCC.
- F. Highlight Submittals that are on the critical path and that require expedited review to meet the schedule. Indicate lead time from Submittal approval to the date of fabrication and installation.
- G. Update and transmit the Submittal/Transmittal log to the Resident Engineer on a monthly basis. Updates will include revisions or additions to Submittals/Transmittals on the log as well as the actual dates.

1.05 SHOP DRAWINGS

A. General:

1. If specified, shop drawings and calculations as submitted shall be signed and sealed by a professional engineer registered in the State of Washington or where the Work will be performed. The shop drawing shall indicate all pertinent features of the products and the method of fabrication, connection, erection or assembly with respect to the Work. Calculations associated with shop drawing design shall also be submitted.
2. The drawing format of the first drawings submitted by Contractor, Subcontractor or vendor will be reviewed for conformance with this Section. Once accepted by Sound Transit, use as the standard for subsequent drawings.
3. Conform to the following standard sizes (in inches).

WIDTH (Vertical)	by	LENGTH (Horizontal)
8.5		11.0
11.0		8.5
11.0		17.0
17.0		22.0
22.0 Maximum		34.0 Maximum

- B. Dimensioning: Follow applicable dimensioning and tolerance practices as specified in ANSI/ASME Y14.5.

1. Prepare Contract-specific information, drawn accurately to scale. Do not base shop drawings on reproductions of the Contract Documents or standard printed data.
 2. Provide sufficient dimensions on drawings so that size, shape and location may be determined without calculation.
 3. Show each dimension clearly so that only one interpretation is possible. Show each dimension for a feature only once.
 4. Show dimensions between points, lines or surfaces having a necessary and specific relationship to each other or which control the location of mating parts or components.
 5. Select dimensions and arrange to avoid the accumulation of tolerances that might ultimately permit more than one interpretation resulting in unsatisfactory mating of parts and / or failure in use.
 6. When possible, dimension each feature in the view where it appears in profile or the one depicting its true profile.
 7. Include on the shop drawings details necessary for the installation, maintenance and repair of all equipment provided.
- C. Electronic data for portions of the Contract drawings may be available for use as the basis for preparation of shop drawings or planning the Work. Such electronic files are intended for design intent only and not intended for fabrication purposes. The Contractor must be responsible for all subsequent distributions of such information to Subcontractors and Suppliers and assuring compliance with the restrictions on use. The Contractor must request the electronic media by submitting an executed copy of the "REQUEST AND RELEASE FOR USE OF SOUND TRANSIT ELECTRONIC SURVEY AND ENGINEERING MEDIA" form found at Appendix A. Use of such documents implies Contractor's and Subcontractor's/Supplier's agreement to the terms on the form. Fully describe requirements and use for each request.

1.06 PRODUCT DATA

- A. If information must be specially prepared for Submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
- B. Mark up manufacturers' standard drawings, catalog cuts, brochures, diagrams, schedules, performance charts, illustrations, calculations, printed installation, erection, application, placing instructions and other descriptive data to highlight information that is applicable to the Contract. Indicate dimensions, clearances, performance characteristics, capacities, wiring and piping diagrams and controls. Supplement standard information with additional information applicable to this Contract.
- C. Submit Product Data before or concurrent with related Samples.

1.07 SAMPLES

- A. Submit Samples for review of kind, color, pattern and texture for a check of these characteristics with other elements and for a comparison of these characteristics between Submittal and actual component as delivered and installed.
- B. Maintain sets of accepted Samples at Site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine the acceptability of construction associated with each set. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Samples, not incorporated

into the Work or otherwise designated as Sound Transit's property, are the property of and will be returned to Contractor.

- C. Samples for Verification: Submit full-size units or Samples of size indicated, physically identical with material or product proposed for use.
1. Samples include, but are not limited to, the following:
 - a. Partial sections of manufactured or fabricated components
 - b. Small cuts or containers of materials
 - c. Complete units of repetitively used materials
 - d. Swatches showing color, texture and pattern
 - e. Color range sets
 - f. Components used for independent testing and inspection.
 2. Number of Samples:
 - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation and other similar characteristics are to be demonstrated.
 - b. If variation in color, pattern, texture or other characteristic is inherent in material or product represented by a Sample, the Contractor shall submit at least three (3) comparison sets of Samples that show the approximate range limits of the variation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONTRACTOR'S RESPONSIBILITIES

- A. Review each Submittal and Transmittal, including all those provided by Subcontractors and Suppliers of any tier, to check for conflicts and coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions.
- B. Review approval methods and requirements of the various designated approving authorities (i.e. AHJ, permitting agency, etc.). Determine typical review time periods of these approving authorities. Include sufficient time in the Schedule for these reviews and approvals. Obtain their approvals in a timely manner in order to avoid adverse impacts to the Contract Milestones.
- C. Attend meetings requested by the Resident Engineer to address issues related to the condition, review and approval of Submittals

3.02 RESIDENT ENGINEER'S RESPONSIBILITIES

- A. The Resident Engineer receives, reviews and takes other appropriate action on all Submittals and Transmittals that are received from the Contractor.
 1. Shop drawings, Samples and other submission reviews by the Resident Engineer will not include checking of dimensions or openings for potential conflict.

2. The Resident Engineer's acceptance of a specific item will not indicate acceptance of an assembly of which the item is a component.
 3. Submittals not required by the Contract Documents may be returned by the Resident Engineer without action.
 4. Incomplete Submittal packages will be returned without review.
 5. Approval of a Submittal is not approval for substitution for a specified item.
- B. For each Submittal reviewed and requiring response by the Resident Engineer, the Resident Engineer will issue a Submittal review document with one of the following statements:
1. NO EXCEPTIONS TAKEN: Denotes the Submittal conforms to the requirements of the Contract Documents and that fabrication and installation may proceed without a resubmittal.
 2. EXCEPTIONS AS NOTED - RESUBMISSION NOT REQUIRED: Denotes that the Submittal conforms to the Contract Documents with the reviewer's corrections incorporated. Resubmittal, prior to proceeding, is not required unless the Contractor takes exception to the reviewer's comments.
 3. EXCEPTIONS AS NOTED - RESUBMISSION REQUIRED: Denotes the Submittal conforms to the Contract Documents with the reviewer's corrections incorporated. The Submittal must be revised to incorporate the corrections and resubmitted to the Resident Engineer for verification and approval, prior to proceeding with fabrication and installation.
 4. REJECTED: Denotes the Submittal is deficient to the degree that the review cannot be completed and that the Submittal must be revised and resubmitted.
- C. Transmittals will be reviewed by the Resident Engineer for conformance with the Contract requirements. The Resident Engineer will not respond to a Transmittal unless there is a defect in the Transmittal document or the Transmittal indicates non-compliance with the Contract. In the case of a defect the Resident Engineer will return the Transmittal with the classification of "Exceptions as Noted – Resubmission Required" or "Rejected" or a non-compliance report will be issued as appropriate. Transmittals found to be acceptable will be so noted in the tracking software program and retained in the Contract Records by the Resident Engineer.

3.03 RESUBMISSIONS, DISTRIBUTION AND USE

- A. Make resubmissions in same form and number of copies as initial Submittal. Note the date and content of previous Submittal. Clearly indicate extent of revision.
- B. Furnish copies of final Submittals to manufacturers, Subcontractors, Suppliers, fabricators, installers, AHJ and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- C. Retain complete copies of final Submittals on Site. Use only final Submittals that are marked with "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED – RESUBMISSION NOT REQUIRED" notation from Resident Engineer's action stamp.

END OF SECTION

APPENDIX

Appendix A: Request and Release for Use of Sound Transit Electronic Survey and Engineering Media

APPENDIX A: REQUEST AND RELEASE FOR
USE OF SOUND TRANSIT ELECTRONIC
SURVEY AND ENGINEERING
MEDIA

Name of Firm requests the following Sound Transit electronic CAD/CAE/BIM data for their use for **name/numeric designation of project**:

Purpose: describe the proposed use

Media Requested: (list and describe the required files and format below)

In consideration for receiving the CAD/CAE/BIM data, **Name of Firm** waives and releases Sound Transit from any claim arising out of the **Name of Firm**'s use of the CAD/CAE/BIM data, and further understands and agrees:

1. **Name of Firm** will use the CAD/CAE/BIM data files solely for the purposes stated.
2. Sound Transit does not warrant the accuracy of the CAD/CAE/BIM data files and they may not represent the as-built condition. **Name of Firm** is solely responsible to verify the accuracy of the electronic files and existing conditions for its purposes.
3. Sound Transit makes no representation or warranty that the CAD/CAE/BIM data is complete, appropriate, or fit for the stated purpose, and such determination rests solely with **Name of Firm**.
4. All CAD/CAE/BIM data provided by Sound Transit to **Name of Firm**, including any electronic revisions, shall remain the property of Sound Transit.
5. **Name of Firm** will indemnify, defend, and hold harmless Sound Transit, its consultants, and agent(s) from any and all damages and claims arising from authorized or unauthorized use of these files.

These provisions apply to any subsequent updated information provided to **Name of Firm**.

Requested by:

SIGNED: _____ DATE: _____

NAME (PRINT): _____

FIRM: _____

TITLE: _____

END OF APPENDIX

SECTION 01 35 29.30

HEALTH, SAFETY, SECURITY AND EMERGENCY RESPONSE

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Sound Transit does not develop or manage the safety and health programs or environmental management programs of the Contractor, its Subcontractors, or suppliers, or in any way assume the responsibility for the safety and health of their employees or their protection of the environment.
- B. The Contractor shall be responsible for the health, safety, security and personal protective equipment for the Contractor's employees, Subcontractors, vendors and other individuals on the Work Site or the general public that may be impacted or in proximity to the Work. The Contractor shall be responsible for the protection of the environment that may be impacted by or in proximity to the Work.
- C. Sound Transit may stop work for observed non-compliance with safety and environmental codes, standards, rules or contract requirements. Contractor shall bear all costs associated with any Stop Work order.

1.02 SUBMITTALS

- A. Submit to the Resident Engineer for review and approval a complete Site Safety and Security Plan (SSSP - Exhibit A) that meets the intent and requirements of a project-specific safety plan and a corporate Accident Prevention Plan (APP) within seven (7) days after the effective date of Notice to Proceed (NTP). The completed SSSP shall include project specific hazard plans as necessary (i.e. confined space, fall protection).
- B. All Contractor employees and Subcontractors shall have all adequate site and task-specific training as documented on the project-specific SSSP. Sound Transit (ST) is not responsible for content of submitted plans. However, ST reserves the right to comment on and require changes to the submitted plans.
- C. When applicable, all track access permits, ST required training records, activity hazard analyses, all other required and approved documentation, and worker awareness and coordination shall be completed and be readily available for review onsite. All work within or near rail right of way must be coordinated with the Resident Engineer prior to any on-site work to assure proper permits, training and procedures.

1.03 SAFETY PRECAUTIONS

- A. Work on or near (distance dependent on operating line) any light rail or commuter rail tracks requires training of all workers and supervisors prior to conduct of the work. Work on or near rail tracks must be coordinated sufficiently in advance to assure Work Permits and Track Access Permits can be obtained. All workers performing work on or near the Right of Way must carry current and valid Right of Way training certification cards and produce them for verification upon request.
- B. Sound Transit considers all confined spaces on Sound Transit property to be permit required confined spaces. Alternate entry procedures are not allowed. Contractor must submit permits and rescue plan to Sound Transit.

- C. Contractor must submit a complete list of chemical products to be utilized on the project along with a Material Safety Data Sheet for each product. Sound Transit is not responsible for review of submitted chemicals or MSDSs. However ST reserves the right to comment on or deny the use of certain chemicals. Chemicals that are low hazard and sustainable are preferred.
- D. Chemical products that will be utilized on Sounder platforms or within 25 feet of BNSF owned tracks must be approved by BNSF prior to use.
- E. To prevent accidental or uncontrolled release of chemicals to the environment, secondary containment must be provided while they are in use or stored on Sound Transit property. Store chemicals indoors, when practical.
- F. When work is performed in an operating public facility, during hours of operation and when members of the public are present, controls must be in place to protect the public from exposure, including perceived exposures, to chemicals, dust, noise or operating equipment. The Resident Engineer may request additional controls be established if complaints are received.
- G. Contractors must utilize fall protection/prevention when walking /working surfaces exceed heights 4 feet.
- H. Contractors must develop a job specific fall protection work plan for work performed at heights greater than 10 feet, if fall protection other than standard guard rails are used. When developing the job specific fall protection work plan, the Contractor must meet with and receive approval from the Resident Engineer to ensure that anchor points and horizontal life lines are sufficient for its purpose.
- I. Contractor performing electrical work must comply with NFPA 70E and other applicable requirements.
- J. Work zones must be demarcated when mobile equipment or powered tools are used in areas open to the public. Demarcation must be sufficient that members of the public, including disabled persons and children, cannot inadvertently or intentionally enter into the work area.
- K. Equipment operators must be trained and certified (as applicable) on the equipment they will be using and have documentation available on-site for review upon request.
- L. When work is performed in an operating public facility, during hours of operation and when members of the public are present, controls must be in place to ensure that accessible paths as required by the Americans with Disabilities Act are maintained and that sufficient work boundaries are established to prevent members of the public who have visual impairments from entering the work area.

1.04 ACCIDENTS

- A. Provide trained personnel, equipment and facilities in order to provide immediate first aid assistance to any who may be injured in the case of accident during the progress of the work. Have a standing, updated emergency procedure with hospital route map, emergency numbers and location of phones clearly posted to immediately assist any person who may be injured or may become ill, or who is rendering assistance to an injured or ill person.
- B. Report immediately to the Resident Engineer and ST's Construction Safety Manager every injury or accident to persons or damage to property; and furnish a report in writing. An accident, injury or illness is any occurrence that results in medical care or treatment beyond first aid. The report shall include full information and details for any and all

accidents including contributing factors and corrective actions to be implemented to avoid future occurrence.

PART 2 - PRODUCTS

2.01 PERSONNEL PROTECTION EQUIPMENT AND SAFETY DEVICES

- A. 100% eye protection (glasses with side shields) compliant with ANSI z.87.1
- B. 100% head protection (hard hat) compliant with ANSI z89
- C. 100% foot protection (boots) compliant with ANSI z41.1
- D. 100% hi-visibility (safety vest) compliant with ANSI/ISEA 107-2010 Class II
- E. 100% hand protection (gloves appropriate for task)
- F. All other PPE shall be approved by applicable safety standards and authorities

PART 3 - EXECUTION

END OF SECTION

EXHIBITS

Exhibit A: Sound Transit Contractor SSSP.

SECTION 01 35 29.30 – EXHIBIT A

SOUND TRANSIT CONTRACTOR SITE, SAFETY, AND SECURITY PLAN

Date Form Completed _____

IX. GENERAL INFORMATION

Your Name	
Company Name	
Company Address	
Company City	
Company State	
Company Zip	
Contact Number	

Please Detail the Proposed Scope of Work: _____

Location of
Project/Work _____

Anticipated timeframe of project, from _____ (date) to _____

On-site Supervisor (print): _____ Phone: _____

On-site Safety and Security Rep (print): _____ Phone: _____

Sound Transit Resident Engineer (print): _____ Phone: _____

II. Project Specific Safety Hazards

List the minimum required PPE: _____

Check the boxes for the hazards or concerns identified for the tasks associated with the scope of work (i.e., fall hazards, hot work, respiratory hazards, confined space, scaffold). **A plan must be submitted for review by Sound Transit for any of the following that are checked:**

- ☐ Scaffold Safety
- ☐ Cranes/Rigging
- ☐ Excavation
- ☐ Utility Clearance and Overhead Hazards
- ☐ ROW Training
- ☐ Fall Protection/Bridge Worker Safety
- ☐ Confined Space
- ☐ Lockout/Tagout
- ☐ Hazardous Waste
- ☐ Hearing Conservation
- ☐ Respiratory Protection
- ☐ Hazard Communications
- ☐ Fire Protection/Prevention
- ☐ Powered Industrial Trucks and Forklifts
- ☐ Bloodborne Pathogen

Other: _____

Other: _____

List measures or controls the contractor is implementing to mitigate these hazards and safety concerns. _____

III. JOB SAFETY BRIEFINGS

The below statements **must be checked** and implemented within your project safety plan; by checking these statements you affirm that they will be accomplished. This SSSP will not be accepted unless these are checked.

- ☐ Job Safety Briefings will be completed at the start of the work shift and as needed during the course of the day; e.g., personnel changes, weather changes, or changes in assignments.

- ☐ Job Safety Briefings will include Emergency Response Information and summarize the location and emergency contact numbers.

IV. EMPLOYEE TRAINING

The below statements must be checked if they apply, and implemented within your safety plan; by checking these statements you affirm that they will be accomplished. This SSSP will not be accepted unless these are checked.

- ☐ *All employees working on a Sound Transit site have completed a job specific Worker Safety Orientation Program.*
- ☐ *All employees working on Central Link, who will be working within 10' of track, have completed a Sound Transit Roadway Worker Protection/On-Track Safety Training, or who are working within 25' of BNSF or Sound Transit commuter rail track have completed both BNSF Contractor Orientation and Roadway Worker Protection classes.*
- ☐ *All work activities within 4' of Tacoma Link rail, 10' of Central Link rail or within 25' of BNSF or Sound Transit commuter rail track require a completed and approved Track Access/Work permit.*

List below, other required safety training conducted by/through the contractor company in which your employees, who will be working on Sound Transit property. Copies of training programs do not need to be provided. *Safety Training needs to be conducted by/through the contractor company.*

- ☐ Identify the project competent person for those tasks, equipment, or machinery that requires related training.

V. EMERGENCY PREPAREDNESS

Written Emergency Preparedness information needs to be at the job-site with work groups. For projects in fixed work locations complete the following. For work groups that will be on the move during the course of a project this information needs to be updated as necessary and maintained with each work group.

Central Link Control Center Phone Number is: (206) 205-8177

Sound Transit 24-hour Emergency Phone Number is: (206) 398-5268

BNSF ROCC Phone Number is: (800) 832-5452

The below statements must be checked and implemented within your safety plan; by checking these statements you affirm that they have been accomplished. This SSSP will not be accepted unless these are checked.

- ☐ **Job Safety Briefings will include emergency preparedness information.**
- ☐ **Copies, if required, of Material Safety Data Sheets (MSDSs) for hazardous materials will be provided to the Sound Transit Resident Engineer and be maintained on-site.**

Address and street intersections adjacent to the job-site:

For Medical, Fire, or Police **Call 911.**

Inform all employees of the site address and major adjacent intersections.

Attach a hospital route map to this SSSP

Verify project communications: ☐Landline ☐Radio ☐Cellular telephone
and

The below statements must be checked and implemented within your safety plan; by checking these statements you affirm that they will be accomplished. This SSSP will not be accepted unless these are checked.

- ☐ First Aid and CPR trained employees will be at the job-site(s) and identified during job safety briefings.
- ☐ A First Aid Kit and fire extinguisher will be available at the job-site

Note: Identify and assign where an employee will meet emergency response personnel, i.e. at an intersection, gate/fence, and other location

☐ The Sound Transit Resident Engineer will be notified immediately after any injury requiring time loss, and within 24 hours for any DOSH recordable injury. All injury or property loss incidents will be investigated using root cause analysis. Investigation reports will be submitted to Sound Transit within seven (7) days and will include root causes and corrective actions.

☐ The Sound Transit Resident Engineer will be notified immediately after any spill to soil, storm water systems or a water body, or large enough that it cannot be contained by one on-site

person, and within 24 hours for any spill greater than 5 gallons that was contained onsite. All spill incidents will be investigated using root cause analysis. Spill reports will be submitted to Sound Transit within seven (7) days and will include root causes and corrective actions.

VI. FIRE PREVENTION

Hot Work activities will be performed?: ☐ Yes ☐ No

The below statements must be checked and implemented within your safety plan; by checking these statements you affirm that they will be accomplished. This SSSP will not be accepted unless these are checked.

- ☐ Hazard Assessment activities and Pre-task safety briefing will identify procedures and equipment available for fire prevention and suppression, as well as, locations where equipment will be staged.
- ☐ In Right-of-Way areas, Sound Transit operations contacted to confirm approval for hot work and document restrictions. Ensure location is known for emergency assistance.

VII. SAFETY AUDITING

Formal safety audits/surveillance of on-site work activities will be conducted at the following frequency (e.g. twice/week, weekly): _____

The below statements must be checked and implemented within your safety plan; by checking these statements you affirm that they will be accomplished. This SSSP will not be accepted unless these are checked.

- ☐ Assessments will include a full list of work activities, safety procedures, hazard mitigation, site controls as well as the identification of physical hazards.
- ☐ Reports of audit findings will be documented and submitted for review by Sound Transit Construction Safety.

Identify which contractor personnel who will conduct and review Safety Audits with the ST safety representative:

Name (print): _____ Phone: _____

VIII. SAFETY COMMUNICATIONS PLAN

In addition to Job Safety Briefings, briefly describe the daily pre-task briefing for safety-related information and a list of all site personnel that participated in the daily site briefing.

Briefing Topic: _____

List All Meeting Attendees (print):

IX. ROADWAY WORKER PROTECTION/ON-TRACK SAFETY INFORMATION

For contractors working near track or on station platforms, mark what applies to your work group and verify that the following items are in place before starting work:

- ☐ Completed applicable roadway worker protection plan/on-track safety programs
 - ☐ Tacoma Link ☐ Central Link ☐ Sounder/BNSF ☐ Amtrak
- ☐ Will require and have been assigned a safety watch, flagger or platform lookout
- ☐ Track Access/Work Permit approved and activated
- ☐ Will utilize or require on-track equipment with trained and certified operators
- ☐ Not Applicable (No workers within specified distances by line from track)

THIS COMPLETED SSSP SHALL BE SUBMITTED TO THE ST RESIDENT ENGINEER. ADDITIONALLY, PRINT A COPY OF THIS SSSP. KEEP A COPY AT ALL WORK SITES AND GIVE ONE TO EACH OF YOUR ON-SITE WORK-GROUPS.

FOR CONTRACTOR WORK GROUPS WORKING WITHIN OR NEAR A RIGHT OF WAY, A COPY OF YOUR ROADWAY WORKER PROTECTION/ON-TRACK SAFETY PROGRAM MUST BE MAINTAINED WITH EACH WORKGROUP.

END OF EXHIBITS

SECTION 01 35 43

HAZARDOUS AND CONTAMINATED SUBSTANCE HEALTH AND SAFETY PROGRAM

PART 1 - GENERAL

1.01 SUMMARY

This Section includes requirements for the preparation and implementation of health and safety procedures for dealing with known Hazardous or Contaminated Substances and developing plans to manage unknown, unexpectedly encountered Hazardous or Contaminated Substances.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents.
 - 1. Code of Federal Regulations (CFR)
 - a. 29 CFR 1910 Occupational Safety and Health Standards
 - b. 29 CFR 1926 OSHA Construction Standards
 - 2. Environmental Protection Agency (EPA)
 - a. SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods
 - b. 5035A, Closed-System Purge-And-Trap And Extraction For Volatile Organics In Soil And Waste Samples
 - 3. Washington Administrative Code (WAC)
 - a. WAC 173-303 Dangerous Waste Regulations
 - b. WAC 173-340 Model Toxics Control Act - Cleanup
 - c. WAC 296-843 Hazardous Waste Operations
 - d. WAC 173-350 Solid Waste Handling Standards
 - 4. Washington State Department of Ecology
 - a. Publication 94-49 Guidance on Sampling and Data Analyses Methods
 - b. Publication 97-602 Analytical Methods for Petroleum Hydrocarbons
 - c. Publication 10-09-057 Guidance for Remediation of Petroleum Contaminated Sites
 - 5. Revised Code of Washington (RCW)
 - a. RCW Chapter 70A.305 Model Toxics Control Act (MTCA)

1.03 DEFINITIONS

- A. Certified Industrial Hygienist (CIH): A trained specialist with at least 5 years of experience in Hazardous or Contaminated Substances handling and working knowledge of selection and use of PPE, air monitoring, regulation, and other health and safety issues, and who is currently certified by the American Board of Industrial Hygiene.
- B. Contaminated Groundwater: Groundwater containing levels of contaminants in excess of applicable WAC 173-340, MTCA Method A Groundwater Cleanup levels if other cleanup levels are not specified in the Contract Documents.
- C. Contamination Reduction Zone: Designated area that provides a physical separation between the Exclusion and Support Zones to decontaminate personnel, equipment and vehicles prior to entering the Support Zone from the Exclusion Zone. This area must be clearly identified and designated as a "Caution" zone and can be entered only by employees with Hazardous Waste Operations and Emergency Response (HAZWOPER) certification and who have signed the HCS-HASP.
- D. Contaminated Soil: Soil, sludge or solid waste containing one or more Hazardous or Contaminated Substances at concentrations greater than applicable cleanup levels based on land use. Examples of Contaminated Soil may include, but are not limited to: street sweeping waste, sediment in utilities, and soil with Hazardous or Contaminated Substances from a past release associated site historical activities or soil contaminated by proximity to contaminated groundwater.
- E. Contaminated Substances: Water, groundwater, air, soil containing one or more Hazardous or Contaminated Substances at concentrations greater than the respective Cleanup Level
- F. Contaminated Water: Water containing levels of contaminants in excess of applicable WAC 173-201A, WAC 173-340, 40 CFR 131.45, and Section 304 of Clean Water Act screening relevant criteria. The relevant criteria must be based on the waterbody where discharge is occurring if other cleanup levels are not specified in the Contract Documents. Water may include surface water, stormwater or groundwater discharged to surface water.
- G. Dangerous Waste: Solid wastes designated in WAC 173-303 as dangerous, or extremely hazardous or mixed waste.
- H. Exclusion Zone: Area of exposed contamination designated for Hazardous or Contaminated Substance storage, excavation or removal. All work performed within the Exclusion Zone must be covered in the HCS-HASP by workers who are appropriately HAZWOPER certified as specified in this Section. The exclusion zone must be clearly marked and designated as a "Danger" zone. Methods must be in place to keep non- designated people out, and to only allow entrance of those employees with HAZWOPER certification and who have signed the HCS-HASP.
- I. Hazardous Air Contaminant: Any air contaminant considered by regulatory agencies to cause or contribute to an identifiable and significant increase in mortality or to an increase in serious irreversible or incapacitating reversible illness and for which no ambient air standard exists.
- J. Hazardous Building Materials (HBM): Materials regulated by law because of potential health and environmental risks. HBM includes asbestos containing material, lead,

mercury and polychlorinated biphenyls (PCBs) that exist in building materials including, but not limited to, walls, floors, ceilings, insulation, caulk, glazing, mastic, paint, light fixtures, fireproofing, and equipment (WAC 296-62; 40 CFR 761.50).

- K. Hazardous or Contaminated Substances Health and Safety Plan (HCS-HASP): A supplemental plan to the Contract requirements which establishes in detail the protocols necessary for protecting workers, on-site personnel, visitors, potential off-site personnel and the public from potential hazards that may be encountered during excavation, stockpiling, handling, sampling, transporting and disposing of Hazardous or Contaminated Substances. This plan must meet the requirements of a Health and Safety Plan as specified in WAC 296-843-120.
- L. Hazardous Material: Another term for Hazardous Substances.
- M. Hazardous Waste: Solid wastes designated by 40 CFR Part 261, and regulated as hazardous and/or mixed waste by the United States EPA.
- N. HAZWOPER: Hazardous Waste Operations and Emergency Response: The Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) applies to five distinct groups of employers and their employees. This includes any employees who are exposed or potentially exposed to hazardous substances -- including hazardous waste -- and who are engaged in operations as specified by 1910.120(a)(1)(i-v) and 1926.65(a)(1)(i-v).
- O. Health and Safety Action Levels: Action levels established to minimizing potential Hazardous or Contaminated Substances exposure to Contractor personnel, Sound Transit personnel, personnel representing third party stakeholders and the public.
- P. Impacted Substances: Solid Waste containing detectable levels of contaminants less than applicable MTCA cleanup levels as specified in the Contract Documents. Substances may be subject to regulatory or location-specific requirements for end use at off-site locations or facilities. Presence of Impacted Substances may also trigger an Administrative Order under the National Pollution Discharge Elimination System permit (NPDES)
- Q. MTCA: Washington State Model Toxics Control Act, Chapter 70A.305, RCW
- R. Permissible Exposure Limits (PEL): Maximum amount or concentration in air for each contaminant that a worker may be exposed to under Washington State Department of Safety & Health (DOSH) and OSHA regulations.
- S. Personal Protective Equipment (PPE): All clothing and other work accessories designed to create a barrier against workplace hazards. Examples include safety goggles, blast shields, hard hats, hearing protectors, gloves, respirators, aprons and work boots.
- T. Cleanup Levels: Cleanup levels established in accordance with MTCA WAC 173-340 based on land use at the location of the substance. Substances with chemicals greater than Cleanup Levels are considered contaminated.
- U. Site Safety and Health Officer (SSHO): A trained specialist in health and safety with a minimum of 3 years of experience and working knowledge of PPE use, regulations and hazard identification.
- V. Solid Waste: as defined in WAC 173-350.
- W. Support Zone: Area designated to provide an entry and exit for personnel, materials

and equipment through the Contamination Reduction Zone to the Exclusion Zone, as an area for support facilities and storage of clean work equipment. Workers may rest, eat and drink in this area.

- X. Unknown Hazardous or Contaminated Substance Screening and Handling Plan (UHCS-SHP): A plan detailing how new discoveries of unknown but suspected Hazardous or Contaminated Substances are to be screened, segregated, sampled, handled and disposed.

1.04 SUBMITTALS

A. General

- 1. Contractor must modify their plans when project information changes and must notify the Resident Engineer when changes or modifications are required. Review and approval of such modifications must require a resubmittal as directed by the Resident Engineer.

B. Submittals

- 1. HCS-HASP: Within 30 days after Notice to Proceed (NTP).
- 2. UHCS-SHP: Within 30 days after NTP.
- 3. Updated HCS-HASP(s): Within 3 days following discovery of new contamination.
- 4. CIH Qualifications and Certifications: Within 30 days after NTP.
- 5. SSHO Qualifications and Certifications: Within 30 days after NTP

C. Air monitoring instrument calibration and data sheets

D. Reports

- 1. Security and training logs and worker compliance agreements
- 2. Safety inspection logs, daily and weekly health and safety reports, and a closeout health and safety report
- 3. Close-out documents or Cleanup Action Report for Unknown Hazardous or Contaminated Substances.
- 4. Emergency and accident report(s) within 24 hours following each occurrence

1.05 QUALITY ASSURANCE

A. Qualifications and Certifications

- 1. CIH:
 - a. Minimum of 5 years of experience in managing employee health and safety when working in Hazardous or Contaminated Substances
 - b. Current certification in first aid and cardiopulmonary

resuscitation (CPR)

- c. Demonstrable experience in Personal Protective Equipment (PPE) selection and use, health hazard analysis of Hazardous or Contaminated Substances, decontamination processes, air monitoring techniques and site control measures
- d. Working knowledge of local, state and federal health and safety regulations
- e. Completion of required OSHA Training in accordance with CFR 1926.120 and WAC 296-843, including completion of 40-hour HAZWOPER training and completion of 3 days on-site training by a fully qualified instructor or mentor, and 8-hour annual update HAZWOPER refresher training.
- f. Current certification with the American Board of Industrial Hygiene

2. SSHO:

- a. Minimum of 3 years of experience supporting employee health and safety protection programs when working with Hazardous or Contaminated Substances
- b. Current certification in first aid and cardiopulmonary resuscitation (CPR)
- c. Working knowledge of local, state and federal health and safety regulations
- d. Completion of required OSHA Training in accordance with CFR 1926.120 and WAC 296-843, including completion of 40-hour supervisory training and completion of 3 days on-site training by a fully qualified instructor or mentor, and 8-hour annual update HAZWOPER refresher training

3. Laboratories: The independent qualified testing for soil, water, air, and vapor samples must be a Washington State Department of Ecology accredited laboratory as applicable (WAC 173-50) with quality assurance and controls sufficient to complete a Level 2a validation. The independent qualified testing laboratory for asbestos air and personal air samples must be a satisfactory participant in the NIOSH Proficiency Analytical Testing (PAT) program and American Industrial Hygiene Association (AIHA) accredited laboratory.

B. Responsibilities

1. CIH:

- a. Responsible for certifying the HCS-HASP, all task-specific HCS-HASPs, selecting PPE, and all additions and modifications thereto.
- b. Required to be accessible to the SSHO as necessary, to assist in the identification and evaluation of potential hazards and the development of appropriate procedures for addressing known or suspected conditions or activities that may pose routine occupational hazards or

immediate danger to life or health of work site personnel, Sound Transit personnel, utility crews working in the construction area, personnel related to third party stakeholders or the public.

- c. Evaluate health and safety hazards when changes in conditions occur or are identified
- d. Review results of environmental sampling of suspected contaminated soils, groundwater, surface water or other substances
- e. Specify personal exposure monitoring protocols and procedures.

2. SSHO:

- a. Required to be on site and present during Hazardous and Contaminated Substance Work to be completed as part of the Contract. Such work includes, but is not limited to: air monitoring, hazardous materials removal, removal of contaminated soil and groundwater, removal of Underground Storage Tanks (UST), and work related to the presence or potential for unknown contaminated materials.
- b. Responsible for the development, implementation, enforcement and monitoring of the HCS-HASP for the project.
- c. Responsible for conducting the pre-construction indoctrination, Pre-Entry Briefings and other periodic training of on-Site personnel with regard to contents of the HCS-HASP and other safety requirements to be observed during construction.
- d. Responsible for performing air monitoring as required by the HCS-HASP.

C. The CIH and the SSHO have the authority to:

- 1. Suspend field activities if health and safety of work site personnel, Sound Transit personnel, other crews working at the Project Site, or the public are endangered.
- 2. Suspend individuals from field activities due to infractions of the HCS-HASP.
- 3. Suspend field activities if Unknown Hazardous or Contaminated Substances are identified during field activities until the Hazardous or Contaminated Substances are characterized, the HCS-HASP is updated and field personnel have been trained on the HCS-HASP updates.

D. Instruments used for air monitoring must be maintained and calibrated as specified in the manufacturer's instructions and user manuals.

PART 2 - PRODUCTS

2.01 PERSONAL PROTECTIVE EQUIPMENT

- A. As identified in the HCS-HASP and/or as selected by the CIH which are appropriate for the hazards likely to be encountered, required tasks, duration, and site requirements and limitations.

2.02 AIR MONITORING EQUIPMENT

- A. Instruments required by the CIH and specified in the UCS-SHP and HCS-HASP. Instruments must be suitable for providing continuous readings and capable of detecting the contaminants of concern.

2.03 FIELD SCREENING EQUIPMENT

Selected by the CIH:

- A. Photoionization detector (PID) able to perform headspace analysis and able to detect contaminants of concern

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform work required by the Contract in a safe and environmentally acceptable manner. Provide for the safety of site personnel, Sound Transit personnel, personnel representing third party stakeholders and the public for the duration of the Contract.
- B. Maintain a current HCS-HASP conforming to applicable federal, state and local statutes, rules, regulations and ordinances, in effect at the time the Work is performed.
- C. Maintain a UHCS-SHP detailing procedures to follow in the event that suspected Unknown Hazardous or Contaminated Substances is identified during the course of work to ensure that all applicable federal, state and local statutes, rules, regulations and ordinances in effect at the time the Work is performed are met for work in areas of Hazardous or Contaminated Substances.
- D. Ensure that personnel working with Hazardous or Contaminated Substances (e.g., soil, groundwater or other environmental media) have current HAZWOPER training and are thoroughly briefed on the anticipated hazards, safety equipment to be employed, safety practices to be followed, and emergency procedures and communications, and have reviewed and signed the HCS-HASP. The signed HCS-HASP must be kept on the job site and be made available for inspection. Do not allow personnel who are not properly trained to enter or to work in areas identified as containing or suspected to contain Hazardous or Contaminated Substances.
- E. Develop and maintain on site industrial hygiene information including right-to-know information, such as Material Safety Data Sheets (MSDS).
- F. If an emergency condition arises during the Contract:
 - 1. Immediately suspend work activities associated with this Contract in the vicinity of the area of the emergency.
 - 2. Notify the Resident Engineer.
 - 3. Secure the area as needed to restrict and protect Work Site personnel and the public from exposure to the emergency condition.
- G. Meetings: The SSHO must conduct daily and weekly health and safety meetings with the workers throughout the duration of all Hazardous or Contaminated Substance work.

The SSHO must discuss each day's activities and associated health and safety issues with the workers and address concerns and issues that the workers may have. Hold the weekly meeting at the beginning of the workweek.

- H. Train all workers on work compliance according to the HCS-HASP and UHCS-SHP.
- I. Distribute the HCS-HASP and UHCS-SHP to personnel on site (contractor, subcontractor, construction management consultants and Sound Transit) who are likely to encounter Hazardous or Contaminated Substances. Require employees to read the plan, sign the plan and abide by its provisions. Display or make the plan available at the Site to employees, Sound Transit representatives and regulatory inspectors.

3.02 HAZARDOUS OR CONTAMINATED SUBSTANCE HEALTH AND SAFETY PLAN (HCS-HASP)

- A. Prepare and implement a HCS-HASP in accordance with the requirements of applicable local, state and federal requirements and this specification section for work in areas of documented Hazardous or Contaminated Substances and for work performed once new discoveries of Hazardous or Contaminated Substances are found. Include, as a minimum, the following Site-specific information:
 - 1. Site Description and Evaluation
 - 2. Comprehensive work plan
 - 3. Site Map including demarcation of zones
 - 4. Names of key personnel and alternates responsible for site safety and health (responsible party) lines of communication and chain of command, including site safety and health officer. Include the responsibilities of each
 - 5. Emergency contact names and telephone numbers
 - 6. Map to nearest emergency medical services
 - 7. Site specific safety and health hazard assessment and risk analysis based on Hazardous or Contaminated Substances known or expected to be present.
 - 8. Training requirements
 - 9. Personnel Protective Equipment
 - 10. Medical Surveillance
 - 11. Air Monitoring Program
 - 12. Site Control Measures (Work Zones, Communications and Security)
 - 13. Personnel Hygiene and Decontamination
 - 14. Equipment Decontamination
 - 15. Sanitation
 - 16. Logs, Reports and Record Keeping
 - 17. Noise, Heat and Cold Stress, and other physical hazard monitoring

18. Emergency Response including evacuation routes and procedures
 19. Include qualified personnel who are fully HAZWOPER trained and certified, as required, for Hazardous or Contaminated Substances site work in accordance with all other applicable federal, state and local statutes, rules, regulations and ordinances.
 20. Spill containment plans
 21. If unexpected Hazardous or Contaminated Substances are found, refer to UHCS-SHP and include requirement to stop work until the HCS-HASP can be updated with a revised hazard assessment.
 22. Drug handling protocols
 23. Site Specific Hazard Communication
 24. Material Safety Data Sheets (MSDS)
 25. Accident Prevention Plan
 26. Specific requirements for Hazardous Building Materials work, if asbestos has been identified on the site. Reference may be made to the Hazardous Building Material Work Plans (asbestos, lead etc.) as required in the Contract Documents.
 27. Reference list of the environmental reports reviewed in the preparation of the HCS-HASP
- B. The HCS-HASP must be regularly reviewed as work progresses and more information becomes known, including discovery of additional Hazardous or Contaminated Substances. Accordingly, the HCS-HASP should be updated as needed.

3.03 UNKNOWN HAZARDOUS OR CONTAMINATED SUBSTANCE SCREENING AND HANDLING PLAN (UHCS-SHP)

- A. Prepare and implement a UHCS-SHP that documents how discoveries of suspect Hazardous or Contaminated Substances are to be handled when found in locations not identified in the Contract Documents. Include the following at minimum:
1. Identification of responsible environmental personnel including the Environmental Compliance Manager (ECM), CIH, SSHO, Certified Erosion Sediment and Control Lead (CESCL) and other relevant personnel.
 2. Methods for identification and screening of suspected Hazardous or Contaminated Substances.
 3. Methods for securing and restricting access to the suspected areas of Hazardous or Contaminated Substances including immediate suspension of work activities associated with this Contract in the vicinity of the area of the suspected Hazardous or Contaminated Substances. Securement of the area as needed to restrict and protect work site personnel and the public from exposure. Set up and designate Exclusion Zone and Contamination Reduction Zones using "Danger" tape to identify the Exclusion Zone and "Warning" tape to

designate the Contamination Reduction Zone.

4. Notification protocol for the identification of suspected Hazardous or Contaminated Substances. Notification protocol must include Resident Engineer and Sound Transit Environmental Compliance.
5. Methods for obtaining quantitative data to determine if the Unknown Hazardous or Contaminated Substances are in fact Hazardous or Contaminated Substances and evaluating releases of Hazardous and Contaminated Substances caused by the Contractor during Contractor operations. The methods must include sample collection methods of soil, water, and HBM and appropriate chemical analytical methods to evaluate chemicals of concern based on field screening results, historical use and/or source of Hazardous or Contaminated Substances.
6. Methods and procedures for handling, transportation, disposal, and off-site treatment of Hazardous or Contaminated Substances, including but not limited to soil, groundwater, water and HBM. Methods must be in compliance with this Section, applicable federal, state, and local laws and regulations, including the identification of disposal and treatment facilities, and the use of certified, licensed transporters (also refer to Section 31 23 01 Excavation Spoils Disposal and 02 83 66 Hazardous Building Material Removal and Disposal)
7. Protocol for updating the Hazardous and Contaminated Substances Health and Safety Plan (HCS-HASP) in accordance with the Contract regarding the discovery of previously Unknown Hazardous or Contaminated Substances.

3.04 SITE CONTROL MEASURES

- A. For excavation around suspected underground storage tank locations and for Hazardous or Contaminated Substances, furnish and install Site fencing, warning tapes or other barricades to physically separate the work zones on sites based on the HCS-HASP. Establish the following work zones:
 1. Exclusion Zone: Perform work involving Hazardous or Contaminated Substances inside the Exclusion Zone.
 2. Contamination Reduction Zone
 3. Support Zone
- B. Be responsible for costs associated with cleanup of all Hazardous or Contaminated Substances that may be tracked outside of the Exclusion Zone.

3.05 PERSONAL PROTECTIVE EQUIPMENT

- A. Provide appropriate PPE and ensure that it is kept clean and well maintained. PPE must be selected by the CIH and be appropriate for the hazards likely to be encountered, required tasks, duration, and Site requirements and limitations.
- B. Decontaminate and/or properly dispose of PPE worn on site. Decontaminate and inspect PPE for integrity before being reissued. Unless agreed or required otherwise by Sound Transit, handle used PPE and disposable equipment in accordance with the local, state, and federal requirements for solid waste.

3.06 PERSONAL HYGIENE AND DECONTAMINATION

- A. Define personnel decontamination protocols in the HCS-HASP to be followed by workers performing or supervising work within designated areas or exposed to Hazardous or Contaminated Substances. The HCS-HASP must include a map or diagram of the steps to be followed during decontamination.
- B. Perform decontamination procedures inside the Contamination Reduction Zone.

3.07 EQUIPMENT DECONTAMINATION

- A. Decontaminate vehicles and equipment used during the handling of Hazardous or Contaminated Substances inside the Contamination Reduction Zone before leaving the Site. Collect, treat or dispose of decontamination rinse water at an approved off-site facility.
- B. Keep roads inside the Contamination Reduction Zone free of contamination. Carefully load to avoid contamination of exterior truck surfaces.

3.08 UNKNOWN DISCOVERIES OF HAZARDOUS OR CONTAMINATED SUBSTANCES

- A. Upon discovery of an abnormal condition or indicator of an Unknown Hazardous or Contaminated Substances:
 - 1. Immediately suspend work activities associated with this Contract in the vicinity of the area with Suspect Hazardous or Contaminated Substance.
 - 2. Notify the Resident Engineer immediately after discovery of abnormal condition or Unknown Hazardous or Contaminated Substances.
 - 3. Keep Unknown Hazardous or Contaminated Substances isolated from clean materials. Dispose of material that becomes contaminated as a result of work activities at Contractor's own expense.
 - 4. Secure the area as needed to restrict and protect Contractor personnel, Sound Transit personnel, other project Site workers and the public from exposure to suspected Hazardous or Contaminated Substances.
 - 5. Survey the location of the suspected Hazardous or Contaminated Substances within 24 hours of discovery.
 - 6. Delineate and establish site control measures for:
 - a. Exclusion Zone
 - b. Contamination Reduction Zone
 - c. Support Zone
 - 7. For Unknown Hazardous or Contaminated Substances, place material in a staging unit immediately after removal while awaiting test results. Use and maintain staging units that are in good condition and constructed of materials that are compatible with the substances (solid or liquid) to be staged. Staging units may include stockpiles placed on minimum 6 mils thick plastic sheeting, 55 gallon water-tight barrels, water-tight portable tanks, or water-tight roll-off units lined with 6 mils thick plastic sheeting. Place an impermeable cover over the units to prevent precipitation and stormwater from contacting the

stored Unknown Hazardous and Contaminated Substances. Remove and store liquid that collects inside the units.

8. Staging units with Unknown Hazardous or Contaminated Substances must be clearly labeled with the source, date generated, and type of material. Keep a written log to track the source of Unknown Hazardous and Contaminated Substances in each staging unit.
 9. Provide reasonable assistance to the Resident Engineer in the performance of Sound Transit duties. Such assistance may include: documenting site conditions, providing access, collecting samples (at the direction of the Resident Engineer), providing sampling and analysis of the contents of unknown containers, arranging for the disposal of Hazardous or Contaminated Substances, and attending regular project meetings.
- B. Provide Resident Engineer with appropriate documentation required to notify federal, state and local agencies, as part of the removal, cleanup, mitigation, handling, transportation and disposal of Hazardous or Contaminated Substances. Appropriate documentation may include a Cleanup Action Report or close out documents as directed by Resident Engineer.
 - C. Secure necessary and applicable permits, certificates, licenses and approvals required for the performance of this Work.
 - D. Perform work using only qualified personnel who are fully HAZWOPER trained and certified, as required, for Hazardous or Contaminated Substance site work in accordance with all other applicable federal, state and local statutes, rules, regulations and ordinances. Do not allow personnel who are not properly trained to enter or to work in areas identified as containing or suspected to contain Hazardous or Contaminated Substances.
 - E. Comply with record keeping requirements in accordance with the provisions of this Contract and applicable federal, state and local statutes, rules, regulations and ordinances.
 - F. Do not resume construction operations in the vicinity of the area where an Unknown Hazardous or Contaminated Substances has been discovered or encountered until so directed by the Resident Engineer.
 - G. Coordinate the Work with other Site activities to minimize or avoid delays.
 - H. Dispose of excavated material with Hazardous and Contaminated Substances in accordance with Contract Documents and local, state, and federal requirements including but not limited to WAC 173-303 and WAC 173-350.
 - I. Submit Resident Engineer documentation of offsite disposal facilities' acceptance criteria and associated chemical analytical data of soil to be disposed that meets acceptance criteria prior to transport of soil to facility.
 - J. If landfilling is the chosen disposal option, Sound Transit must sign the waste profile as the generator. The Contractor is responsible for coordinating with Sound Transit and providing sufficient chemical analytical data and information for Sound Transit to verify waste characterization.
 - K. For disposal of all Dangerous Waste, with the exception of those wastes resulting from the release of Contaminated Substances negligently disturbed, removed, or handled by Contractor, its employees, agents, officers, or Subcontractors, or any

other persons for whom the Contractor may be contractually or legally responsible, ensure that the Generator's Certification portion of the Uniform Hazardous Waste Manifest is signed only by Sound Transit's Environmental Compliance Manager or by an individual delegated with such authority by Sound Transit.

3.09 LOGS, REPORTS AND RECORDKEEPING

- A. Maintain logs and reports covering the implementation of the HCS-HASP including the Air Monitoring Program. Include daily logs, weekly reports, audits and a close-out report.
- B. Include in Daily Safety Logs when working in areas of Hazardous or Contaminated Substances, at a minimum, the following:
 - 1. Date
 - 2. Area (site specific) checked
 - 3. Employees in particular area
 - 4. Equipment being utilized by employees
 - 5. Protective clothing being worn by employees
 - 6. Protective devices being used by:
 - a. Contractor's personnel
 - b. Visitors
 - c. Designated local, state and federal representatives
 - 7. Air Monitoring Equipment and Data
 - 8. Work activities for the day and associated health and safety issues discussed during the daily Health and Safety meeting.
 - 9. SSHO signature and date
- C. Include pertinent information from the daily logs in the Weekly Safety log. This report must be a summary of the daily reports filed during that workweek.
- D. Conduct health and safety audits of the Work area and procedure monthly. Prepare an audit report/check list and attach to the current weekly report.
- E. Prepare and submit a health and safety close-out report at the completion of the project. The report must summarize the health and safety issues and associated procedures and resolution for the project.
- F. Prepare and submit close-out document or Cleanup Report as directed by Resident Engineer. Closeout document must include:
 - 1. Summary of excavation and backfill activities, sampling (if completed), disposal.
 - 2. Surveys of excavation area including cross-sections of areas of excavation.
 - 3. Analytical laboratory test results and chains-of-custody for samples

collected.

4. Bills of Lading, Weight Tickets and/or Certificates of Disposal or Treatment for soil and groundwater

- G. Comply with federal and state laws that require the retention of chemical exposure records and medical records for 30 years after the termination of the job. MSDSs are considered exposure records under these regulations.

3.11 SCREENING, SAMPLING AND ANALYSIS

- A. Visually screen all soil and water excavated for staining, unusual odors, debris, slag, or sheen to evaluate the presence of contamination. Visually inspect building materials for suspect Hazardous or Contaminated Substances not noted in HBM surveys. Field screening tests may be used to screen for Unknown Hazardous and Contaminated Substances. Field screening tests may include water sheen test for the evidence of petroleum hydrocarbons and headspace measurements with the PID for evidence of volatile organic compounds. Notify Resident Engineer of new discoveries as specified herein.
- B. Perform required sampling and chemical analyses relating to generation, use, release and disposal of Hazardous or Contaminated Substances in the course of Contractor operations, in accordance with the UHCS-SHP and SPCC plan.
- C. Perform required sampling and chemical analyses relating to Unknown Hazardous or Contaminated Substances unless otherwise provided in the Contract Documents or as directed by the Resident Engineer in accordance with the UHCS-SHP. Include characterization sampling and the sampling necessary to determine presence or absence of Hazardous or Contaminated Substances and evaluate disposal methods accordingly. Do not dispose of material until directed to do so by the Resident Engineer.
- D. After Unknown Hazardous or Contaminated Substances is removed, confirmation samples will be collected and analyzed by the Sound Transit or Contractor as directed by Resident Engineer. Based on test results, Contractor to proceed with additional removal that may be required as directed by the Resident Engineer. Mark locations of samples and extent of excavation in the field and document on the surveys and the as-built drawings.

3.12 AIR MONITORING

- A. The CIH must design, develop and implement an Air Monitoring Program to detect and quantify airborne contaminants present during the Work in order to evaluate the inhalation exposure for workers. Submit the details of this program as part of the HCS-HASP.
- B. Monitor air for Hazardous Air Contaminants in breathing zones when work is being conducted in known and suspected hazardous or contaminated areas.
- C. Information gathered during the Air Monitoring Program must be used by the CIH to determine appropriate safety and personnel protective measures and medical monitoring to be implemented during excavation, stockpiling, handling, sampling, transporting and disposing of Hazardous or Contaminated Substances.
- D. Assess off-site migration of air-borne contaminants released during work activities.
- E. Calibrate and maintain air monitoring instruments in accordance with manufacturer's

recommendations.

F. Monitor air:

1. For potential explosive hazards:
 - a. During excavation and handling of Hazardous or Contaminated Substances
 - b. During handling of materials suspected of containing Hazardous or Contaminated Substances
 - c. In confined spaces.
 - d. Where explosive gases were previously detected.
2. During excavation, use a monitoring instrument to evaluate levels of Hazardous Air Contaminants.
 - a. Air monitoring is intended to provide warning and evaluate appropriate action to be taken to minimize exposure to Hazardous or Contaminated Substances.
 - b. Conduct continuous air monitoring in the areas of known and suspected Hazardous or Contaminated Substance to evaluate the presence of volatile organic compounds.
3. During demolition, quantitatively evaluate levels of particulate lead and asbestos as described in Contract Documents.
 - a. Asbestos and PCB-containing materials may be present in some buildings as indicated on the Contract Drawings.
 - b. Lead-based or lead-containing paint is expected to be present in all buildings.

G. Action Levels

1. If significant staining, sheen, odor, debris, or other evidence of Hazardous or Contaminated Substances is observed in areas where Hazardous or Contaminated Substances were not anticipated, cease all work in the area. Do not continue work in the area until potential risks are evaluated and as directed by the Resident Engineer.
2. The CIH must develop appropriate Health and Safety Action Levels to minimize exposure by Contractor personnel, Sound Transit personnel, personnel representing third party stakeholders and the public. Include action levels in the HCS-HASP. Action Levels must be below the PEL.
3. Ensure that action levels are appropriate for the contaminants of concern.
4. If concentrations of contaminants exceed the Health and Safety Action Levels established by the CIH, cease all work in the area until potential risks can be evaluated further, and immediately notify the Resident Engineer.
5. Site-specific Cleanup Levels have been established for this project as documented in the Contract Documents. If Cleanup levels have not been documented the applicable MTCA Method A cleanup level must be used.

END OF SECTION

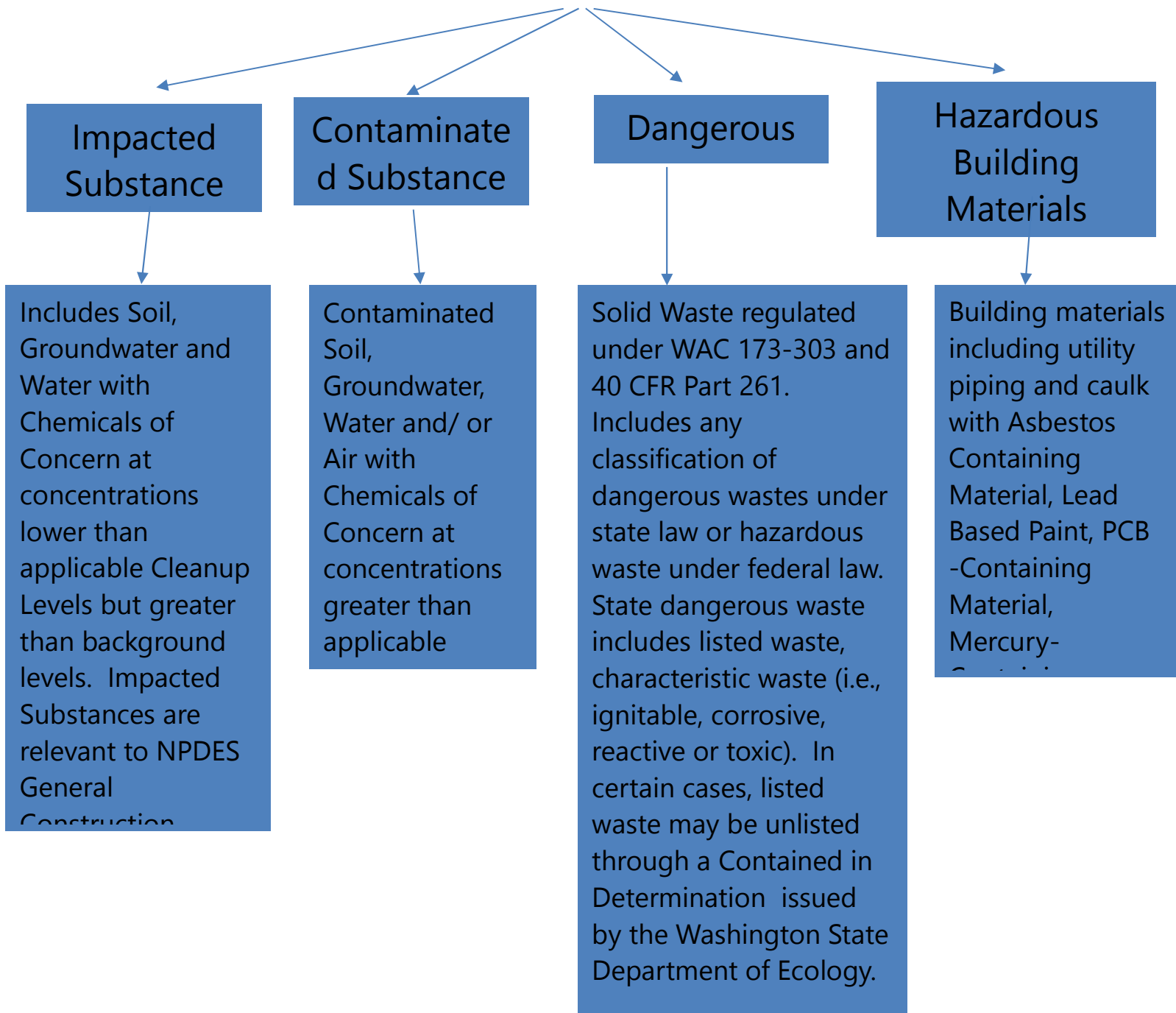
EXHIBITS

Exhibit A: Types of Hazardous or Contaminated Substances

**Exhibit A – Types of
Hazardous or
Contaminated
Substances**

**Hazardous Or Contaminated
Substances**

Include, But Not Limited To



END OF EXHIBIT

SECTION 01 45 00.30
QUALITY MANAGEMENT
DESIGN-BID-BUILD & GC/CM

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section defines the requirements for the Contractor to establish, implement, and maintain an effective Quality Program to manage, control, document, and ensure and verify the Work complies with the requirements specified in the Contract Documents. This Section also defines the requirements for the Contractor to prepare, implement, and maintain plans, programs, procedures, and the organization necessary to assure quality for materials, equipment, workmanship, manufacturing, and installation operations covering both on-site and off-site Work by the Contractor, including Subcontractors, Subconsultants, Suppliers, and Testing Laboratories.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section as specified and modified.
1. Federal Transit Administration (FTA):
FTA Quality Management System Guidelines Current Version
 2. International Building Code - Structural Tests and Special Inspections (Chapter 17) or Local Authority Having Jurisdiction's (AHJ) Building Code
 3. American Society for Testing and Materials (ASTM) Standards
 4. Washington Association of Building Officials (WABO) Requirements
- B. Definitions:
1. Construction Work Plan (CWP): Detailed plan for constructing a specific Work activity.
 2. Readiness Review Meeting (RRM): A meeting to review and discuss all CWP elements identified below which is conducted by the Resident Engineer with the Contractor, Subcontractors and applicable third party representatives who are involved in executing, supervising, inspecting, testing and monitoring the Work activity.
 3. Inspector's Daily Report (IDR): A daily report to be completed by all Inspectors identifying work activities observed, inspected and documented.

1.03 CONTRACTOR QUALITY PERSONNEL REQUIREMENTS

- A. Employ qualified QC Inspectors meeting, at a minimum, the following requirements:
1. QC Inspectors shall have a minimum of 5 years construction QC experience for the Work they are responsible for inspecting or with a minimum of 3 years QC inspection experience plus a minimum 2 years construction experience in

engineering or inspecting within the disciplines for the Work they are responsible for inspecting.

2. QC Inspectors report directly to Project Manager and cannot be responsible for directly performing, supervising or progressing the Work or have responsibilities for this Contract that conflict or appear to conflict with their primary responsibilities for quality matters.
 3. Only designated and approved QC Inspectors may perform quality inspections. Other personnel, such as the Contractor Field Engineers or Superintendents, cannot perform as QC Inspectors.
 4. Field QC Inspectors cannot perform testing, unless they are employed by the Independent Test Lab that will perform the tests on the samples taken.
 5. QC Inspectors are responsible for reviewing, understanding, verifying and documenting in the IDR that the requirements of the approved CWP, drawings, specifications, shop drawings and other applicable Submittals are implemented on each Feature of Work by observing the construction Site Work activities, inspecting the Work activities and documenting the results of the inspections in the IDRs.
 6. At the sole discretion of Sound Transit, the Contractor may be required to replace QC Inspector(s).
- B. Mobilize the number of experienced QC Inspectors, qualified to the type of Work being performed for each Feature of Work that is necessary to perform the QC inspections with at least 1 QC Inspector for each discipline of Work being performed per worksite per shift. The number of QC Inspectors shall be coordinated with the Resident Engineer. At the sole discretion of the Resident Engineer, the Contractor shall provide additional QC Inspectors, if the Resident Engineer determines that additional QC Inspectors are required.

1.04 QUALITY MEETINGS

- A. Conduct Quality Meetings every 2 weeks with the RE along with additional Sound Transit representative(s) as required, the Contractor Project Manager along with other Contractor representative(s) including QC Inspectors and Third Parties (if required) to discuss quality issues. Items discussed will be documented by the Contractor and shall include due dates of assigned action items with agreement from the RE. Quality meetings may be combined with progress meetings with agreement from the RE. Distribute minutes to all attendees and other interested parties. At a minimum, the Quality Meetings shall cover topics of:
1. Three-week look-ahead schedule update
 2. CWP status and RRM's
 3. RFIs
 4. Status of Submittals for upcoming work activities
 5. Safety Critical submittals
 6. Inspection coverage for upcoming work activities
 7. Special Inspections and tests
 8. Upcoming tests, procedures and test results update
 9. Status of NCRs
 10. Status of materials received and inspected

11. Off-site activities
12. Updates to as-built Contract documents
13. Quality issues, recurring issues and actions taken

1.05 SUBMITTALS

- A. Inspection and Test Plan with Matrix within 45 days after the effective date of the NTP. Submittal must be acceptable to Resident Engineer with a No Exceptions Taken (NET) or Exceptions as Noted Resubmission Not Required (EANRNR) disposition before any Construction Work that requires inspection can begin.

Inspection and Test Matrix, include the following:

1. Specification Section number
 2. Specification Section title
 3. Section Article
 4. Test/Inspection Description
 5. Standard procedure
 6. Identify on-site/off-site testing
 7. Minimum frequency or instance for tests and inspections
 8. Entity responsible for performing tests and inspections
- B. Quality Control (QC) Inspectors. Include:
 1. Name and qualifications
 2. Discipline of Work to which they will be assigned
 - C. Name and qualifications of the Contractor's Independent Testing Laboratory and all subcontracted Testing Laboratories within 45 days after the effective date of the NTP.
 - D. List of CWP's, within 45 days after the effective date of the NTP. Update the CWP list when new CWP's are added and resubmit within 7 days .
 - E. CWP's required by the CWP List submittal.
 - F. Independent Testing Laboratory Inspection and Test Reports, within 7 days after completion of the inspection or test.
 - G. List of Subcontractors and Subconsultants within 45 days after effective date of NTP. Provide updates at least 10 days prior to each new Subcontractor or Subconsultant beginning Work on Contract.
 - H. IDR form, including content and items as identified in Exhibit A. The Contractor may use IDR form provided herein.
 - I. Contractor IDRs, within 2 days of inspection (as Submittals) for the first 4 weeks after the start of inspection or as otherwise directed by the Resident Engineer. Thereafter, provide IDRs to the Resident Engineer thereafter as a Transmittal, within 2 days of inspection.
 - J. Completed Utility Strike Log, within 7 days after Acceptance. Provide copy of interim Utility Strike Log when requested by Sound Transit.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 DOCUMENT CONTROL

- A. All documents shall comply with Document Control Requirements in accordance with Section 01 31 25, Document Control and Internet-Based Document Management System.
- B. Provide process procedures in compliance with Section 01 31 25, Document Control and Internet-Based Document Management System for:
 - 1. Meetings: Agenda, Minutes, Distribution, and Filing
 - 2. RFI Management
 - 3. Change Order Management

3.02 SUBCONTRACTOR, SUBCONSULTANT, AND SUPPLIER CONTROL

- A. Submit a list of Subcontractors and Subconsultants including Work to which they will perform, and provide updates prior to each new Subcontractor or Subconsultant beginning Work on Contract.
- B. Assure all products and services procured from Subcontractors, Subconsultants and Suppliers meet Contract Document requirements.
- C. Develop and maintain procurement procedures to select and control Suppliers and Subcontractors including:
 - 1. Evaluation and assessment of Suppliers' and Subcontractors' quality systems
 - 2. Methods utilized to monitor quality performance of Suppliers and Subcontractors
 - 3. Flow down of design, reliability and quality requirements to Suppliers and Subcontractors
 - 4. Determination of criteria for performing source inspections

3.03 IDENTIFICATION, TRACEABILITY AND RECEIVING, HANDLING, STORING AND CONTROLLING OF PRODUCTS, MATERIALS, AND EQUIPMENT

- A. Establish and maintain procedures for receiving, handling, storing, identifying and controlling items of production (batch materials, parts, components and subassemblies) to prevent use of incorrect or defective items and to ensure only correct and acceptable items are used or installed.
 - 1. Provide identification and traceability during all phases of production from receipt of raw materials, components and subassemblies through the manufacturing process to the delivery of final products and systems.
 - 2. Utilize batch number, shipment number, packing slips or invoices along with test data sheets and material certifications for determining traceability of raw materials.
 - 3. Provide physical separation, procedural control or other appropriate means where physical separation is impractical or where record traceability is lost.

4. Employ storeroom or inventory tracking procedures for traceability of items back to a particular order number, batch number, date received, test lot or other pertinent source.
 5. Employ routing documentation for traceability of assemblies in production.
 6. Mark final assemblies with Contract number, model number, serial number and bar codes.
- B. Inspect and record on the IDR identification, damage and quantity of all products, materials and equipment received. Large lots may be inspected by an industry approved standard sampling method.
 - C. Record on the IDR on-site equipment calibration occurrences including the piece of equipment, equipment identification number/label, name(s) and company of personnel performing the calibration, qualifications (if applicable), brief outline (or document reference) of the procedure including equipment used to perform the calibration and next calibration due date.
 - D. All products, materials and equipment are subject to receipt inspection by Sound Transit.

3.04 PROCESS CONTROL

- A. Control on-site and off-site construction through the development of Contractor CWP's, approval of CWP's by the Resident Engineer, execution of the Work in accordance with CWP's and Contract requirements, and timely reporting of the results of the inspections on the IDR and lab test reports of required inspections and tests.
- B. Determine, in consultation with the Resident Engineer, which Work activities require submission and approval of a CWP. Prepare and submit a list of CWP's to the Resident Engineer for concurrence and approval. The Resident Engineer and the Contractor may add CWP's to the list. Resubmit the CWP list when CWP's are added, deleted or modified.
- C. CWP's: Prepare and submit a CWP for each of the Work activities identified on the CWP list. Work cannot begin without Sound Transit acceptance of a CWP dispositioned as NET or EANRRN and convening of a RRM. No partial approval of a CWP will be permitted. Changes and revisions to the Work activity require a revised CWP to be submitted and a new RRM to be held prior to resuming Work. As a minimum include, in the order listed, the following in each CWP:
 1. Scope of Work
 2. List of persons responsible for supervision of the Work
 3. List of required approved submittals (for example; traffic control plans and special processes), drawings (with latest revisions) and the job hazard analysis
 4. Planned start-work and completion dates, progress rate expected and Work hours
 5. Sequence of events and construction methods for performing the Work: Include Sound Transit hold points and inspection requirements
 6. Handling and storage of materials and equipment
 7. Inspection and Test hold points required where the next process step or activity will cover up the Work. Add hold points inspection at the RE's discretion.
 8. Inspections and tests required by Contractor, Third Parties and Sound Transit

9. Individuals responsible for performing inspections and providing input to as-built drawings
10. Prerequisite activities and related construction safety issues
11. Off-site inspection and test activities and their locations
12. Procedures for controlling hazardous materials, as applicable
13. Erosion and Sediment Control (ESC) Best Management Practices (BMP)
14. Actions defined as "Special Events", which may expose the public to danger or inconvenience, and which may require a third party to be notified
15. Safety-critical installations, inspections and tests
16. Specific Job Hazard Analysis (JHA) for each CWP

D. CWP and RRM

1. After the CWP has been returned by the Resident Engineer dispositioned as NET or EANRNR and a minimum of 7 and a maximum of 14 days before beginning associated Work activities, attend the RRM conducted by the Resident Engineer. The Resident Engineer documents the meeting with an agenda and minutes of the meeting including an attendance record. Include an activity for each RRM on the Project Schedule.
2. All Submittals associated with the CWP must be listed in the CWP Submittal.
3. After the RRM has been held and updates (if any) have been incorporated into the CWP, the Contractor shall distribute the revised CWP and approved associated Submittals to the personnel performing the Work and to the Contractor QC Inspectors. The Contractor and/or its Subcontractor personnel shall keep a copy of the approved CWP and approved associated Submittals within proximity of the Work being done and shall adhere to the approved processes and procedures contained therein. The Contractor or Subcontractor personnel performing the Work shall produce a copy of the approved CWP and approved associated Submittals upon request by QC Inspectors, Resident Engineer team or Sound Transit personnel.

E. Control of Special Processes

1. Perform special processes (e.g., welding, brazing and soldering) only with personnel certified in accordance with the requirements of the specific processes. Maintain qualification records of personnel performing special processes in the worksite files, submit to the Resident Engineer for approval and reference in the applicable CWPs. Submit qualifications of new personnel and recertifications to the Resident Engineer on an ongoing basis during the Contract.
2. Obtain Sound Transit approval of qualifications of personnel performing special processes.

3.05 INSPECTION AND TESTING

A. Independent Testing Laboratory

1. Employ the services of an Independent Testing Laboratory to perform on-site testing, as well as off-site testing to confirm the acceptable quality of materials, parts, and equipment required by the Contract Documents. Independent Testing Laboratory must have special inspection capability and certification. Independent

Testing Laboratory shall be in compliance with ASTM E329 and be currently certified by a nationally or state-recognized regulatory agency or an industrially sponsored organization. The Contractor cannot self-perform as an Independent Testing Laboratory even if Contractor staff is WABO certified.

2. Obtain Sound Transit authorization to use the Independent Testing Laboratory before commencing Work for which testing is required by Contract Documents. Obtain Sound Transit authorization before changing or adding Independent Testing Laboratories.

B. Inspection and Test Plan

1. Prepare and submit Inspection and Test Plan with a Matrix defining the types and frequency of inspections and tests, and the entity responsible for performing each inspection and test (e.g., Laboratory, Contractor, Subcontractor or Third Party).
2. Update the Inspection and Test Plan whenever an Independent Testing Laboratory is added, or when an inspection or test is added by Change Order or a Change Notice-Work Directive.
3. Perform all QC inspections including QC inspections prior to owner conducted Special Inspections. The Contractor shall:
 - a. Prepare a schedule of Special Inspections required.
 - b. Notify Resident Engineer in advance of date of performance of Special Inspections.
 - c. Coordinate Work to ensure the next step in the process does not obscure the ability to inspect until the required inspections have been completed.
 - d. Document all inspections and test results in the IDR. Include whether the test passed or failed.
 - e. Provide photos of Work.
4. Adjustments to control procedures and CWP's may be required based upon results of inspections and tests. Document inspection and test results of the in-process inspections in the IDRs.
5. Report inspection and test compliance or noncompliance with the Contract requirements specified or indicated in the Contract Documents.

C. Special Inspections and Tests

1. Where required by permits and / or building codes of the Authority Having Jurisdiction (AHJ), Sound Transit will contract with a WABO qualified testing laboratory and / or special inspector to conduct Special Inspections and tests.
2. Special Inspection and Test Coordination: Notify Resident Engineer not less than 7 days in advance of Work requiring Special Inspections and tests within the State of Washington; provide not less than 10 days in advance of Work outside of the State of Washington. Do not proceed with the Work until a hold point has been released by the Resident Engineer. Cooperate fully with these special inspectors and provide all assistance necessary to complete their inspections.

D. Control and Calibration of Inspection, Testing, and Monitoring Equipment

1. Calibrate and certify all testing equipment and monitoring devices. Document in calibration log. Calibration and certification requirements include the following and

apply to the Contractor and all Subcontractors, Suppliers and Independent Testing Laboratories:

- a. Be able to trace calibration to known national standards and document in calibration log.
- b. List inspection, test and monitoring equipment with the name and serial number, date of current calibration, due date of next calibration and name of person or laboratory conducting the certification or calibration with a brief description of use.
- c. Store all testing equipment and monitoring devices in a safe and secure location, maintained throughout the Contract and used only for testing or monitoring Work for which they are designed.
- d. Re-calibrate, re-test and re-inspect materials, parts and equipment, if the inspection or testing equipment is suspected of being out of calibration, broken, dismantled or damaged. Document in calibration log.
- e. Make all testing and inspection equipment certified calibration records available and display on the equipment calibration sticker showing the last date of calibration, the due date of the next calibration and the name of the calibration laboratory/company.
- f. All on-site calibrations are to be witnessed by the Resident Engineer or Resident Engineer staff at the option of the Resident Engineer. Provide notification to the Resident Engineer of scheduled on-site calibrations 7 days prior to the calibration.

E. Inspection and Test Reporting

1. Inspection and test reports are considered Contract Record documents. Require parties performing testing and inspections to verbally transmit information regarding failed inspections and tests on the same day as discovery to the Contractor. Document failed test results on IDRs. Upon receipt of the failed inspections or test information, notify the Resident Engineer by e-mail within 1 day of the failed inspection or test results.
2. Upon discovery of nonconformance Work, no action shall be taken to cover or obscure the Work that is the subject of a failed inspection until it is corrected and re-inspected or otherwise approved by the Resident Engineer. At its discretion, Sound Transit may issue a Nonconformance Report (NCR).
3. Include the following minimum requirements in Inspection and Test Reports:
 - a. Sound Transit Contract number
 - b. Reference to Contract Specification Section requirement or test procedure
 - c. Identification of items tested
 - d. Location where sample was taken (i.e., stationing and intersection corner)
 - e. Quantity of items inspected or tested
 - f. Date inspection or test was conducted
 - g. Name of technician
 - h. Acceptance criteria

- i. Pass or Fail disposition
 - j. Results
 - k. Authorized signature
- F. Contractor-performed and Subcontractor-performed inspections and tests are subject to witnessing, verification, and approval, including approval of documentation, by the Resident Engineer.

3.06 NONCONFORMANCE AND CORRECTIVE ACTION

- A. Upon receipt of a Nonconformance Report (NCR) (or other nonconformance documentation mechanism) from Sound Transit, the Contractor is responsible for: Investigate and describe the root cause of the nonconformance, providing remedial Corrective Actions for the nonconformance item(s), providing Preventive Actions to prevent recurrence and recommending a disposition. Submit NCR to the Resident Engineer within 14 days of discovery of the nonconformance Work. Payment will only be made for Work which is in full compliance with the Contract. Complete all REWORK within 30 days from the date that the nonconformance condition was documented. Complete REPAIR within 30 days after the approval of NCR, unless additional time is requested in writing by the Contractor and approved by the Resident Engineer. The applicable category designations for NCRs are:
 - 1. USE AS IS: allows the use of an item that does not meet specified Contract requirements without the need for Corrective Action, but may require some compensation to Sound Transit as allowed elsewhere in the Contract Documents. ("USE AS IS" NCR, including photos, will be routed by the Resident Engineer to the Sound Transit Quality for review and approval.)
 - 2. REPAIR: item may be repaired if it cannot be reworked to be brought into full compliance with the Contract requirements, but it can be made suitable for use. ("REPAIR" NCR, including photos, will be routed by the Resident Engineer to the Sound Transit Quality for review and approval.)
 - 3. REWORK: item may be reworked to bring it into full conformance with the Contract requirements. REWORK only applies to conditions where a discrete item can be completely replaced (e.g., bolt). Any changes which are not replacements in part or in whole are considered a REPAIR. The Resident Engineer has final authority to determine the category to which Work is assigned in a NCR condition. Contractor is required to provide photo documentation of nonconforming Work to the Resident Engineer.
 - 4. REJECT: item is Defective and considered unsuitable for its intended use, is economically or physically incapable of being reworked or repaired, and must be replaced to bring it into conformance with the Contract requirements. These items may be scrapped or returned to the Supplier. Contractor is required to provide photo documentation of Defective Work to the Resident Engineer.
- B. For REPAIR, or REWORK, compile documentation of the NCR for Resident Engineer verification of Corrective Action implementation. Include IDRs and photos of the Nonconforming Work prior to, during and after Corrective Action clearly labeled with the date, time and description of activities.
- C. Resident Engineer is responsible for submittal of required documentation to the Sound Transit Quality.
- D. Tag or otherwise identify nonconformance items requiring REWORK, REPAIR or USE AS IS. No follow-on Work that integrates with that item can be performed until REWORK or

REPAIR is completed and accepted, or a USE AS IS disposition and the NCR is accepted by ST Quality.

- E. Red-tag and remove or isolate all Defective items, identified as REJECT, from the Site within 72 hours of discovery.
- F. Provide to the Resident Engineer documentation of utility strikes involving existing utilities within 1 day of the occurrence and within 24 hours record the strike on a Utility Strike Log. Provide the Utility Strike Log to Sound Transit upon request.
 - 1. The Utility Strike Log shall include the following:
 - a. Location
 - b. Date and time of occurrence
 - c. Survey coordinates and elevation
 - d. Utility Type
 - e. Size of Utility
 - f. Name/Description of Utility
 - g. Circumstances leading to the strike
 - h. Date and time of repair after completion
 - i. Contractor performing repair
 - j. Date of acceptance by the Utility owners
 - 2. The Resident Engineer in conjunction with the affected utility entity will determine the work required to appropriately repair the utility strike.
 - 3. Record all utility strikes and repairs on the as-built drawings within 3 days after strike, or as otherwise approved by the Resident Engineer.

3.07 QUALITY RECORDS

- A. Quality Records are a subset of the Contract Records and that document or reflect the quality of the Work. Submit or transmit Quality Records as listed herein.

3.08 QUALITY TRAINING

- A. Provide training to personnel performing Work activities affecting quality of the processes and the product. Maintain records of the training including attendance sign-in records, curriculum, tests, certifications, and training materials as well as qualification and certification documents of personnel who have received training for special processes from outside training organizations.
- B. Provide construction training to Quality Control (QC) Inspectors. Provide a training schedule to the Resident Engineer.

END OF SECTION

EXHIBITS

The following list of Sound Transit Forms and Templates are provided by Sound Transit and are required to be used for the duration of the project. Periodic updates may be issued by Sound Transit.

1. Exhibit A - IDR
2. Exhibit B - Inspection and Test Matrix Form

If the Contractor has an equivalent form they wish to use, they must submit the proposed form to Sound Transit for review and approval. Acceptance of the proposed forms is at the sole discretion of Sound Transit.

SECTION 01 45 00.30 - EXHIBIT A
INSPECTOR'S DAILY REPORT (IDR) FORM (2 PAGES)

Date:		Report No.:	
Project Description:		Project Location:	
Contract Unit #:		WEATHER	
Contractor:		Sunny:	☐
CM Team:		Rain	☐
Inspector:		Low Temp	☐
Work Shift:	Day: ☐	Swing: ☐	Graveyard: ☐
Work Location:			

Job Site Safety / Incident /Accident

Contract Work Performed – include scope, quantity, location, drawing nos., inspections, tests, activity ID# and calibration records(if available)

Change Order / Work Directive / T&M Work Performed – include scope, quantity, location, and CO or WD Number

Third Party Work- include scope, quantity, inspections

Nonconformance Work – Include defective work notification, if issued

Contractor / Subcontractor Manual Craft Person Count																						
Contractor / Subcontractor or Name (Category)	Crew #	Shift Length	Foreman	Carpenter	Electrician	Laborer	Landscaper	Finisher	Operator/Oiler	Surveyor	Teamster	Iron Worker	Driller	Bricklayer	Plumber	Pile Buck	Flagger	Welder	Lineman	Inspector/Test Tech	Other – Describe in	Total
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Work Force																						0

Work Force Notes

List Major Equipment Types				
Contractor / Subcontractor Name(s)	Equipment Type(s)	Hours		
		Working	Idle	Down Time

Materials Delivery / Manifests – Basis Code for Acceptance: 1. App'd Mtrl List; 2. Insp.; 3. Mtrl Cert.; 4. Plant Cert.					
Material	Basis Code	Buy America		Quantity Received	Remarks
		Yes ☐	No ☐		
		Yes ☐	No ☐		
		Yes ☐	No ☐		
		Yes ☐	No ☐		
		Yes ☐	No ☐		

Signatures			
Inspector Signature		Contractor Signature	
Date		Date	
Inspector Name		Contractor (Print Signature Name)	

Attachments – check as appropriate

Photographs	☐	Surveyor Daily Report	☐
T & M Sheet	☐	Special Inspector Daily Report	☐

SECTION 01 45 00.30 - EXHIBIT B

INSPECTION AND TEST MATRIX FORM

Section	Title	Section Article	Test/Inspection Description	Standard Procedure	On/Off Site	Minimum Frequency or Instance	Test/Inspection By

END OF EXHIBITS

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies general requirements for furnishing, installing, operating and maintaining temporary facilities and controls.

1.02 REFERENCES

- A. Reference Standards: This Section incorporates by reference the latest revisions of the following documents:
1. ASTM International (ASTM):
 - a. ASTM A392 Zinc-Coated Steel Chain-Link Fence Fabric
 2. National Fire Protection Association (NFPA):
 - a. NFPA 13 Installation of Sprinkler Systems
 - b. NFPA 14 Installation of Standpipes and Hose Systems
 - c. NFPA 70 National Electrical Code (NEC)
 - d. NFPA 70E Standard for Electrical Safety in the Workplace
 - e. NFPA 130 Fixed Guideway Transit and Passenger Rail Systems with Seattle Amendments.
 3. Manufacturers Standardization Society (MSS):
 - a. MSS SP 58 Pipe Hangers and Supports – Materials, Design and Manufacture
 - b. MSS SP 69 Pipe Hangers and Supports – Selection and Application
 - c. MSS SP 89 Pipe Hangers and Supports – Fabrication and Installation Practices
 4. Municipality:
 - a. Applicable municipality Fire Code and amendments
 - b. Applicable municipality standard specifications for road, bridge and municipal Construction
 - c. Applicable municipality standard plans
 5. Washington State Department of Transportation (WSDOT):
 - a. WSDOT Standard Specifications for Road, Bridge and Municipal Construction, Division 9-28

b. WSDOT Standard Plans

B. Definitions

1. Authority Having Jurisdiction: Municipality or agencies that have multi-municipality/county jurisdiction
2. Municipality: local political entity(ies) and / or county(ies) in which the Work of this Contract occurs.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. When there is anticipated to be 2 or more contractor's operations overlapping in the construction area, see the Contract Interface requirements specified elsewhere in the Contract Documents for coordination, provision of utilities by one contractor to another and handover requirements.

1.04 SUBMITTALS / Transmittals

A. Submittals

1. Staging Area Management Plan:
 - a. Prepare a Staging Area Management Plan that includes a layout of the construction sites and identifies staging areas including:
 - 1) Buildings, including field offices
 - 2) Parking
 - 3) Hoisting and bridging
 - 4) Material, equipment and designated receiving/storage areas
 - 5) Temporary fencing and access gates
 - 6) Temporary construction walls
 - 7) Temporary walkways
 - 8) Site lighting
 - 9) First aid stations
 - 10) Project identification
 - 11) Temporary utilities
 - 12) Roads and access locations
 - 13) Wash down areas
 - 14) Designated areas for separating materials to be salvaged or recycled.
 - b. Resubmit staging plans prior to changes to Site layout.

- c. Include all temporary facilities to be handed over to the follow-on contractor(s) in the final submission of the Staging Area Management Plan
- 2. Contractor's Parking Plan: Drawings and parking area narrative. Include the following details:
 - a. Location, size (number of stalls) and access requirements, if any, for off-site parking areas
 - b. Sign locations and text to be posted at each work site and at the Site access locations so employees are knowledgeable where parking is allowed and prohibited
 - c. When parking or staging is provided on private property, include copy of lease, easements, or other agreements from the property owner prior to accessing the property.
- 3. Temporary Offices for Sound Transit Construction Management
 - a. Detailed shop drawings of field office including the furniture and equipment layout, and Utility hookup sizes and locations.
 - b. Manufacturer's product data for materials used to construct trailers, heating and cooling systems, and various required amenities as listed on Attachment A.
- 4. Temporary Fencing
 - a. Traffic Gate Operators and Controls: Shop drawings and data sheets.
 - b. Temporary Fencing – Panic Exit Device: Shop drawings and data sheets.
 - c. A sample of the screening material.
- 5. Temporary Construction Wall
 - a. Construction drawings with details of construction wall including structural and wall members, pedestrian gates and traffic gates.
 - b. Plans for viewing windows.
- 6. Temporary Sewer Connections:
 - a. Drawings of proposed temporary sewers connections.
- 7. Temporary Ventilation System - if tunnel and / or underground construction is part of the Work of this Contract
 - a. Design Plan: Submit to Sound Transit for review prior to submittal for approval by the applicable municipal Fire Department .
 - b. Installation and Test Plan:
- 8. Temporary Standpipe System:
 - a. Design Plan. Submit to Sound Transit for review and comments prior to submittal for approval by the applicable municipal Fire Department .

- b. Installation and Test Plan. Submit to Sound Transit for review and comments prior to submittal for approval by the applicable municipal Fire Department.
- c. Shop drawings, component cut sheets, hydraulic calculations and seismic bracing calculations. Submit to Sound Transit for review and comments prior to submittal for approval by the applicable municipal Fire Department.

B. Transmittals (Not Used)

PART 2 - PRODUCTS

2.01 CHAIN LINK FENCE

- A. Chain link fence shall be zinc-coated complying with the requirements of ASTM A392 installed with 88 percent minimum light block-out polyethylene screening in dark navy blue color. Sound Transit will provide print-ready artwork for a Sound Transit logo to be applied to the polyethylene screening on public-facing fence sections with the top of stylized "T" in the logo 4 feet 6 inches above the ground (Exhibit E.1).

2.02 SIGNAGE

A. MDO Plywood Panel Sign:

- 1. MDO ½ inches plywood (may substitute aluminum composite material)
- 2. Square corners and smooth, uniform surface with smooth finished edges
- 3. Pre-drilled mounting holes
- 4. Surface-applied color digital graphics, minimum 300 dpi
- 5. Clear UV coating overcoat to protect images and allow cleaning of graffiti or dirt

B. Mesh Vinyl Banner:

- 1. Minimum 8 ounce weight water-resistant, PVC coated mesh vinyl material
- 2. Minimum 13 mil thickness
- 3. Minimum 1000 by 1000 yarn denier
- 4. Maximum 40 percent air-flow through
- 5. Printed one side with full color UV inks at minimum 300 dpi
- 6. Finished with grommets approximately every 2 feet
- 7. Hemmed edges with reinforced webbing for additional wind resistance

C. Reflective Aluminum Signs:

- 1. 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: 0.080-inch
- 2. 3M Scotchlite Plus "Blue" or approved equal reflective sheeting with electronically cut graphics on one side

3. 3 inch radius corners for 48 by 48 inch signs and 1.5 inch radius corners for 30 by 36 and 30 by 24 inch signs
4. Pre-drilled mounting holes for signs to be wall mounted
5. Construct in accordance with the Contract Specifications

PART 3 - EXECUTION

3.01 STAGING AREAS

- A. The Contract Documents may describe staging areas that are available for use. These staging areas are not exclusive and may be used by Sound Transit and other Sound Transit contractors as indicated in the Contract Documents at no additional cost to Sound Transit.

3.02 PARKING

- A. Parking facilities for Contractor and subcontractor personnel shall be the Contractor's responsibility.
- B. Unless otherwise indicated, the Contractor is responsible for obtaining and maintaining all Contract required parking and staging areas.
- C. Provide parking in accordance with local ordinances and regulations of the local Authority Having Jurisdiction.
- D. All Subcontractors, Suppliers and individuals associated with Contract activities must use approved routes and parking.
- E. Construction parking shall not impair the existing community parking and traffic conditions.
- F. Parking will not be allowed on city streets.
- G. Failure by any employee on this Contract to observe these rules may be grounds for discipline including discharge of the employee in violation.

3.03 TEMPORARY BRIDGING, HOISTING AND HANDLING MATERIAL DISTRIBUTION

- A. Provide temporary bridging, hoisting and material handling required for the execution of the Work.
- B. If required elsewhere in the Contract Documents, provide temporary bridging, hoisting and material handling required in support of a system-wide contractors' performance of the Work.

3.04 MATERIAL, EQUIPEMENT AND DESIGNATED RECEIVING/STORAGE AREAS

- A. Provide all temporary storage and shop rooms that may be required at the Site for safe and proper storage of tools, materials and equipment.
- B. Remove such facilities prior to Acceptance or within 3 days of receipt of Notice from the Resident Engineer that removal is necessary. The Contractor shall assume responsibility for all expenses associated with such removal.
- C. Storage of gasoline or similar fuels shall conform to NFPA regulations and local fire department regulations.

3.05 TEMPORARY OFFICES FOR SOUND TRANSIT CONSTRUCTION MANAGEMENT

- A. Contractor shall be responsible to provide, operate and maintain the temporary offices for Sound Transit Construction Management.
- B. See Attachment A for requirements.

3.06 TEMPORARY FENCING AND ACCESS GATES

- A. Furnish, construct and maintain all temporary fencing around the Site perimeter as necessary, required or as directed.
- B. Install temporary fencing and gates that are a minimum of 6 feet tall and able to secure the Site as indicated or necessary.
- C. Construct pedestrian gates a minimum of 6 feet wide and traffic gates a minimum of 20 feet wide. Provide wireless controlled electric operators for opening and closing traffic gates at a minimum speed of 20 feet per minute.
- D. Used materials may be employed for temporary fencing, provided such used materials are good, sound and suitable for the purpose intended.
- E. Repair or replace, at no additional cost to Sound Transit, temporary fencing that is damaged from any cause during the progress of the Work.
- F. Contractor shall keep perimeter of temporary fencing free of debris and trash buildup caused by installation of fencing. Where the temporary fencing is built against buildings on adjacent properties the Contractor shall be responsible for cleaning area between the fence and the adjacent buildings.
- G. Prior to Acceptance remove all temporary fencing or, if indicated elsewhere in the Contract Documents, handover, in good condition, the temporary fencing to a follow-on Contractor. Temporary fencing materials that have been removed will remain the property of the Contractor

3.07 TEMPORARY CONSTRUCTION WALLS

- A. Furnish, construct and maintain temporary construction walls as indicated in the Contract Documents.
- B. All wood temporary construction walls shall be painted or be provided with a presentable finish to be approved by the Resident Engineer. Refurbish finish of temporary construction walls annually or as directed by the Resident Engineer. Remove/cover graffiti immediately at no additional cost to Sound Transit.
- C. Repair or replace, at no additional cost to Sound Transit, temporary construction walls that become damaged from any cause during the progress of the Work. Protect art work during refurbishing or routine maintenance of temporary construction walls.
- D. Provide 2-foot by 2-foot viewing windows at the locations indicated or designated by the Resident. Cover these viewing windows with 1/4-inch clear transparent polycarbonate and secure in a manner to prevent unauthorized removal. Repair or replace, as necessary or at the direction of the Resident Engineer, damaged polycarbonate to maintain functionality of the viewing window.
- E. Install, protect and maintain art installations provided by Sound Transit Art at locations along the temporary construction wall designated by the Resident Engineer.

- F. Prior to Acceptance remove all temporary construction walls or, if indicated elsewhere in the Contract Documents, handover, in good condition, the temporary construction walls to a follow-on Contractor. Temporary construction wall materials that have been removed will remain the property of the Contractor.

3.08 TEMPORARY WALKWAYS

- A. Furnish, construct and maintain temporary walkway(s) as indicated in the Contract Drawings.
 - 1. Provide security at all times for walkway.
 - a. Walkway shall be open to the public between the hours of 7:00 A.M. and 6:00 P.M. Monday through Friday except on holidays. Walkway shall be closed outside of these hours and shall be secured with locked gates.
 - b. Flaggers stationed at construction wall/fencing access points shall be responsible for the oversight of security for the walkway.
 - 2. Notify law enforcement and Sound Transit security of all incidents on the walkway.
- B. Provide maintenance and servicing of all temporary walkways throughout the life of the Contract:
 - 1. Inspect walkways daily for trash, graffiti, moss, slippery surfaces, hazards and general conditions.
 - 2. Treat walkways with ice melt during freezing weather.
 - 3. Remove trash daily.
 - 4. Remove graffiti within 24 hours.
 - 5. Repair walkway defects immediately.
 - 6. Maintain and service walkway, signage, footpath, lighting and traffic mirrors as needed to ensure safety for pedestrians.
- C. Prior to Acceptance remove all temporary walkways or, if indicated elsewhere in the Contract Documents, handover, in good condition, the temporary walkways to a follow-on Contractor. Temporary walkway materials that have been removed will remain the property of the Contractor.

3.09 TEMPORARY FIRST AID FACILITIES: Furnish, install, maintain and remove temporary first aid facilities and services at each Site of the Work throughout the construction period

3.10 PROJECT IDENTIFICATION, INFORMATION AND ACCESS SIGNAGE

- A. The Contractor shall furnish, install, maintain and update signage and banners required by the Contract
- B. Required Signs/Banners
 - 1. Install Project Identification Signage prior to Work commencing on Site. Install Resident Engineer Office Signage at sites that include a field office for the Resident Engineer or inspectors.

- a. Project Identification Sign (Exhibit A.1) – 96 by 42 inches medium density overlay (MDO) plywood panel with custom, applied digital graphics, which is post mounted or affixed to the site fencing.
 - b. Resident Engineer Office Sign (Exhibit A.2) – 24 by 30 inches MDO plywood panel sign with custom, applied digital graphics, which is wall or post mounted.
2. Up to 70 square feet of Project Information Banners may be needed each year.
 - a. 24-Hour Construction Hotline Banner (Exhibit B.1) – 96 by 24 inches mesh vinyl banner, which is fence or wall mounted.
 - b. Project Description Banner (Exhibits B.2.1 and B.2.2) – 96 by 42 inches or 120 by 42 inches mesh vinyl banner, which is fence or wall mounted.
 - c. Light Rail System Map Banner (Exhibit B.3) – 30 by 42 inches mesh vinyl banner, which is fence or wall mounted.
3. Provide Business and Pedestrian Access Signage for directing access to impacted businesses and for safe public crossings and accesses. Sound Transit will provide digital graphic artwork for generic pedestrian access signs. For all other signs, Contractor or sign vendor will provide artwork based on content provided by Sound Transit Community Outreach. Up to 80 square feet of signage may be needed each year.
 - a. Large Custom Aluminum Sign (Exhibits C.1) – 48 by 48 inches tripod mounted, reflective aluminum sign with applied vinyl graphics.
 - b. Small Custom Aluminum Sign (Exhibit C.2) – 30 by 24 inches tripod mounted, reflective aluminum sign with applied vinyl graphics.
4. Up to 75 square feet of Construction Update Banner may be needed each year. Sound Transit will provide digital graphic artwork.
 - a. Custom Construction Update Banner (Exhibit D.1) – 96 by 36 inches mesh vinyl banner, fence or wall mounted.

C. Installation

1. Locations and manner of installation of signs and banners will be as shown on the Contract Documents or as directed by the Resident Engineer.
2. Verify that sign components are clean and free of materials or debris that would impair installation. Install level and plumb with sign surfaces free of distortion and other defects in appearance.
3. Install signs so they do not protrude or obstruct according to accessibility standard.
4. Mounting
 - a. Post mounting:
 - 1) Fabricate posts 3 feet longer than height of sign to permit direct burial or embedment in concrete. Use minimum 4 by 4 inch post width.

- 2) Option 1 - Direct Burial: Set sign posts vertically in position with the bottom of the post 3 feet below ground, level and with top of posts 5 feet 6 inches above the ground. Support posts to prevent movement during backfilling operations. Use satisfactory soil or well-graded aggregate as backfill. Provide adequate compaction of the backfill to prevent sign movement. Install signs horizontal and even with top of posts.
 - 3) Option 2 - Cast-in-Place Concrete: Set posts vertically in position with the bottom of the post 3 feet below ground level and with top of posts 5 feet 6 inches above the ground. Support the posts to prevent movement. Fill postholes with concrete. Install sign horizontal and even with top of posts.
 - 4) Option 3 - Preformed Concrete Foundation: Form or core drill holes in concrete foundation at least 3/4 inch larger than dimension of post. Set posts vertically in position with the bottom of the post 3 feet below the top of the concrete foundation and with top of posts 5 feet 6 inches above the ground. Support the posts to prevent movement. Fill the void around the post with non-shrink, nonmetallic grout or anchoring cement. Install sign horizontal and even with top of posts.
 - 5) Use concealed metal fasteners where possible. Use fasteners at the minimum size needed to adequately secure sign. Use fasteners that match the sign finish. Locate connections to be as inconspicuous as possible.
- b. Wall mounting: Use concealed metal fasteners where possible. Use fasteners at the minimum size needed to adequately secure sign. Use fasteners that match the sign finish. Locate connections to be as inconspicuous as possible.
 - c. Fence mounting:
 - 1) Wrap zip ties through banner grommets and around fencing, using sufficient quantity of zip ties for secure attachment.
 - 2) Install banners with tops of banner 5 feet 6 inches above ground.
 - d. Tripod mounting: Mount sign on metal tripod stand, as manufactured by AABCO Barricade Co. or approved equal. Secure sign assembly so as to remain stationary during high winds.
- D. Maintenance: Review signs every month and repair and clean, or replace signs damaged by vandalism or other causes.
- E. Removal: Prior to Acceptance remove all temporary signs and banners or, if indicated elsewhere in the Contract Documents, handover, in good condition, the temporary signs and banners to a follow-on Contractor. Temporary sign and banner materials that have been removed will remain the property of the Contractor.

3.11 TEMPORARY UTILITIES

A. General

1. Determine the need for temporary utility (e.g., water, electricity, gas, sewer, etc.) services required to execute the Work. Make arrangements with utility companies for such services.

2. Provide utilities for Sound Transit construction offices, as necessary or required.
3. Prior to Acceptance remove all temporary utilities or, if indicated elsewhere in the Contract Documents, handover, in good condition, the temporary utilities to a follow-on Contractor. Temporary utility materials that have been removed will remain the property of the Contractor.

B. Temporary Electrical Facilities:

1. Provide and maintain during the course and progress of the Work all electrical power and temporary wiring, feeders and connections required and / or necessary to facilitate the work of all trades and services associated with the Work. Provide electrical power at Contractor's expense.
2. Coordinate with local electrical power provider for all temporary power supplies needed for construction.
 - a. Fully analyze the temporary electrical construction loads to determine the power needed from the local electrical power provider based upon all electrical loads at the Site, such as but not limited to temporary Site lighting, electrically powered equipment (i.e. pumps, air compressors, ventilation, mining equipment, cranes, etc.), temporary construction facilities (i.e. trailers, shops, etc.) and other.
 - b. Be responsible for preparing necessary documentation as required by the local electrical power provider for service to ensure that there will not be any power quality problems for the power grid.
 - c. Coordinate with the local electrical power provider to determine any specific design and/ or coordination requirements, and approvals are required to be obtained.
 - d. Review the proposed location(s) of underground raceways and vaults for power feeder(s) to ensure it(they) will not interfere with other construction activities and Site improvements, and that it is acceptable to local electrical power provider and Sound Transit.
 - e. Acquire all required approvals from the local electrical power provider for equipment to be used.
3. If primary 13kV or 26kV temporary power is required, provide temporary service equipment with pad-mounted metering cabinets to meter power from the local electrical power provider's feeders.
4. Coordinate with the Resident Engineer for:
 - a. Transfer of low voltage 480Y/277 V power supply needed for follow-on construction work.
 - b. Interfacing with the local electrical power provider for routing / rerouting of electrical power feeders for permanent power.
5. Coordinate with the local electrical power provider for scheduling and termination of services.
6. Provide, operate and maintain backup power sufficient to meet the following requirements:

- a. Necessary to sustain essential power at the construction Site (i.e. pumps, ventilation, Site Lighting, security, communications, etc.).
 - b. Additional power necessary to allow for orderly shutdown and, where needed, to sustain stand-by functions of major equipment including but not limited to pumps and cranes.
- C. Temporary Site Lighting
 - 1. Provide lighting of Sites as required to complete the Work. Different lighting levels may be required for worker safety and pedestrian security.
 - 2. Adjust lighting to avoid shining into residential homes and to prevent public complaints, as necessary or as directed by Resident Engineer.
 - 3. Keep lighting as low as possible (in both height and foot-candles) while providing safe working conditions.
 - 4. Provide additional perimeter lighting to provide for safety and for wayfinding of pedestrians, as necessary or as directed by Sound Transit.
 - 5. Provide cut-off luminaires to direct the light onto the construction Site and eliminate glare skyward, onto surrounding properties or at vehicular traffic.
 - 6. Temporary Lighting for Underground Construction (for Contracts that include tunnels or other underground construction):
 - a. Provide temporary lighting that meets the applicable requirements in the underground work area(s) during construction.
 - b. Remove temporary lighting when permanent lighting in the underground work area(s) is operational.
- D. Temporary Sanitary Facilities
 - 1. Provide the required toilet conveniences and washing facilities in locations that are secluded from public observation.
 - 2. Keep facilities in a clean, sanitary condition. Service temporary toilet and washing facilities regularly and secure them to prevent damage by vandals.
 - 3. The use of sanitary facilities in adjacent commercial buildings, tenant areas or other private facilities will not be permitted.
- E. Temporary Water Service:
 - 1. Provide, operate and maintain all temporary water services necessary to facilitate the work of all trades and services associated with the Work. Provide temporary water at Contractor's expense. Furnish all temporary pipes, valves, fittings, connections and meters, as necessary or required.
 - 2. See Attachment B.
- F. Temporary Sewer Connections:
 - 1. Furnish, install and maintain side sewer piping as necessary for the Sound Transit construction offices and Contractor's convenience.
- G. Temporary Drainage and Discharge

1. Provide temporary pumps, piping and controls sized to adequately control and remove drainage water. Drainage water includes normal drainage from seepage, storm, process water and emergency flows from a temporary standpipe. Select and size pump(s) and discharge piping to remove normal and emergency flows throughout the Contract. Emergency flows include the required discharge flow from the temporary standpipe(s).
 2. Provide temporary and portable backup power for pumps as required to assure operations when necessary.
 3. The temporary pumps shall be operated, when necessary, to maintain the work site in a safe and workwise condition. If necessary, operate the pump(s) and discharge system 24 hours a day, 7 days per week until Acceptance. Maintain an inventory of spare pump(s), of quantity and capacity equal to the installed pumps, at the project Site at all times. Provide hoisting or other means to remove and replace pumps.
 4. Treat drainage discharge water as required by the Contract.
 5. The location of the temporary pumps and discharge piping shall not create any hazard to construction or interfere with other temporary facilities.
 6. Temporary pumps at cross-passages (for Contracts that include tunnels or other underground construction):
 - a. Once the sump is constructed at a cross-passage and receiving drainage water, utilize the sump with temporary pumps. Once the permanent tunnel power and control equipment is installed, the Contractor may utilize this equipment for tunnel drainage. Coordinate use of the sump for temporary tunnel drainage with the work shown on the Contract Drawings and in these Specifications.
 - b. When the motor control center (MCC), as required elsewhere in the Contract, is energized, the Contractor may utilize the pump power supply circuits and motor starters provided and installed as a part of this Contract. Determine the correct settings of the protective devices in the permanent power supply and motor control center equipment, and reset and / or resize said devices to the correct settings, as necessary.
 - c. If the temporary sump pump power requirements exceed the ratings of the permanent sump pump power supply or starters, provide another means of supplying power to the temporary sump pumps.
 - d. Determine a sequence of operation for the pumps provided. When the pump controller, installed inside the MCC, is energized, coordinate the sequence of this operation. The sequence is specified elsewhere in the Contract and includes the level transducer for pump ON/OFF operation and float switches for high and low level alarm.
- H. Temporary Ventilation (for Contracts that include tunnels or other underground construction):
1. Provide, install, operate and maintain temporary ventilation in the tunnels and underground areas to meet applicable requirements during and subsequent to excavation activities. As a minimum, provide a ventilation system capable of delivering fresh air to meet the minimum requirements indicated below.

- a. Maintain minimum of 60-feet per minute velocity throughout the tunnel, via mechanical ventilation system at all times work is being carried out in the tunnel. During periods when the tunnel is unoccupied, this requirement may be reduced to 50 percent with the approval of the Resident Engineer.
- b. Deliver a minimum of 100 cfm per horsepower for all diesel-operated equipment and 50 cfm air per person in the tunnel.
- c. Install fans with screens, motors and controls. Provide noise suppressors to maintain noise level within the required limits. The system shall be anchored with seismic vibration isolators.
- d. Provide, install and maintain ductwork, isolation damper, electrical power and all system-associated accessories.
- e. The location and installation of the temporary ventilation shall not create any hazard to construction or interfere with other temporary facilities.

I. Temporary Standpipe

- 1. Provide and maintain a wet temporary standpipe system which meets the minimum requirements described below and as required in accordance with the following:
 - a. National Fire Protection Association (NFPA) 130, Standard for Fixed Guideway Transit and Passenger Rail Systems including AHJ amendments, as applicable
 - b. National Fire Protection Association (NFPA) 14, Standard for the Installation of Standpipes and Hose Systems
 - c. Local AHJ Fire Code
- 2. For tunnel construction utilizing a Tunnel Boring Machine (TBM), the piping system used to supply cooling water for the TBM shall not be used as a temporary standpipe, unless otherwise agreed to by local municipal fire department.
- 3. Size standpipe for the pressure required to provide a minimum of 500 gpm, with a 130 psi residual pressure at the hydraulically most remote hose connection, together with a simultaneous flow of 500 gpm at the next most remote hose connection on the same standpipe and for the test pressure requirements.
 - a. Water Supply: Verify current water supply information with local water utility for this Contract. Information regarding hydrant flow tests can be seen in the Hydrant Flow Profiles Calculation in the Mechanical calculation package.
- 4. Provide fire hose valves spaced not greater than 200 feet apart.
- 5. Provide a 4-way, 2.5-inch fire department connection manifold, minimum 6-inch inlet size and connected to the temporary standpipe, and riser to the ground surface level, terminating in an approved fire department Siamese connection located not more than 100 feet from a fire hydrant.
- 6. Hydro test the entire length of pipe after every 200 feet of new standpipe is added. Test the entire standpipe system at a pressure 50 psi greater than the maximum piping system pressure during the flow conditions stated above. Repair all leaks and retest before system is put back in use.

7. Installation, testing and maintenance of the standpipe shall be performed by individuals who have obtained specific certification in accordance with the local municipal fire department.
8. Maintain an air release valve at the high point of the system.
9. Employ means to prevent freezing of the standpipe during cold weather.
10. The location the temporary standpipe shall not create any hazard to construction or interfere with other temporary facilities.
11. Remove the temporary standpipe after the permanent standpipe system installation is complete and successfully tested. Arrange for temporary connection of the 6-inch fire department connection to the end of the permanent standpipe.

END OF SECTION

EXHIBITS

Exhibits A to E: Examples of Identification Signage, Banners and Logos

ATTACHMENTS

Attachment A: Temporary Offices for Sound Transit Construction Management

Attachment B: Temporary Water Service

SECTION 01 50 00 – EXHIBITS

A.1 – Example of Project Identification/Contractor Sign – 96 x 42 inches



A.2 – Example of Resident Engineer Office Sign – 24 x 30 inches



B.1 – 24-Hour Construction Hotline Banner – 96 x 24 inches



B.2.1 – Example of Project Information Banner 1 – 96 x 42 inches



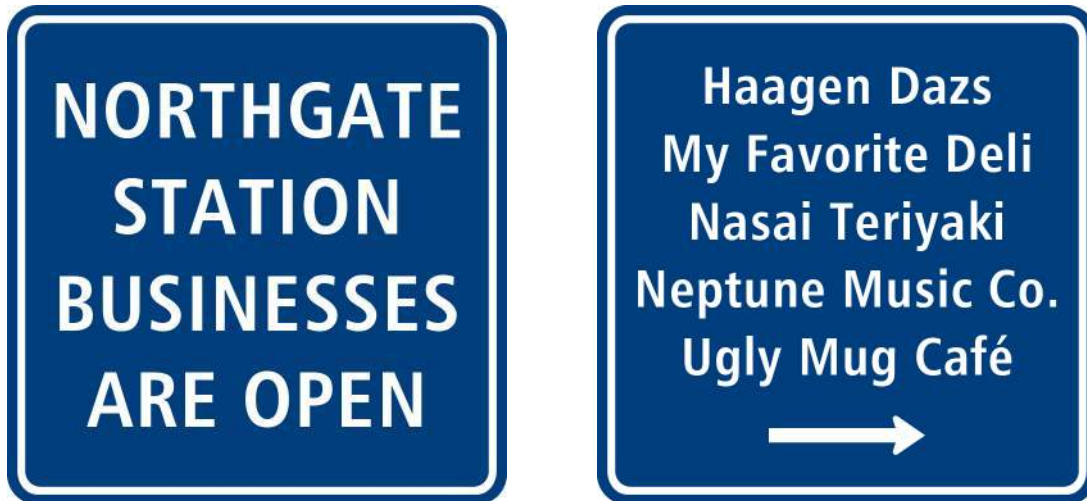
B.2.2 – Example of Project Information Banner 2 –120 x 42 inches



B.3 – Light Rail System Map Banner – 30 x 42 inches



C.1 – Examples of Large Custom Aluminum Sign – 48 x 48 inches



C.2 – Examples of Small Custom Aluminum Sign – 30 x 24 inches



D.1 – Example of Construction Update Banner – 96 x 36 inches

U District Station construction activities

Light rail construction activities (spring – fall 2014)

Construction is underway for the U District Link light rail station. This spring through fall, crews will construct shoring walls, excavate the underground station, and build a temporary roadway bridge along N.E. 43rd Street between Brooklyn Avenue N.E. and University Village N.E. The intersection of N.E. 43rd Street with Brooklyn Avenue N.E. will be closed to motorists during this work.

A pedestrian pathway will provide east-west access between N.E. 43rd Street and Brooklyn Avenue N.E. weekdays (Monday through Friday) from 7 a.m. to 6 p.m. The pathway will be located during evenings and weekends.

Work hours: Typically weekdays from 7 a.m. to 5 p.m. with occasional evening and weekend work.

Shoring walls and station excavation

- Two to three drill rigs building the shoring walls.
- Hoist from drill rigs during piling and tieback installation.
- Potential low-frequency vibration during drilling.
- Over time soil removal and pouring of concrete.
- Frequent truck traffic hauling materials.

Temporary roadway bridge

- High impact noise, including sawcutting, jack hammering and water trucks during daytime hours to remove existing asphalt and material.
- Early morning deliveries of bridge girders and equipment.
- Potential access requests due to staging of large cranes and equipment along N.E. 43rd Street.
- Over time soil removal and pouring of concrete.

Open house

Wednesday, Dec. 11, 2013
6-8 p.m. presentation at 6:30 p.m.
 Neptune Theatre
 1303 NE 45th St., Seattle

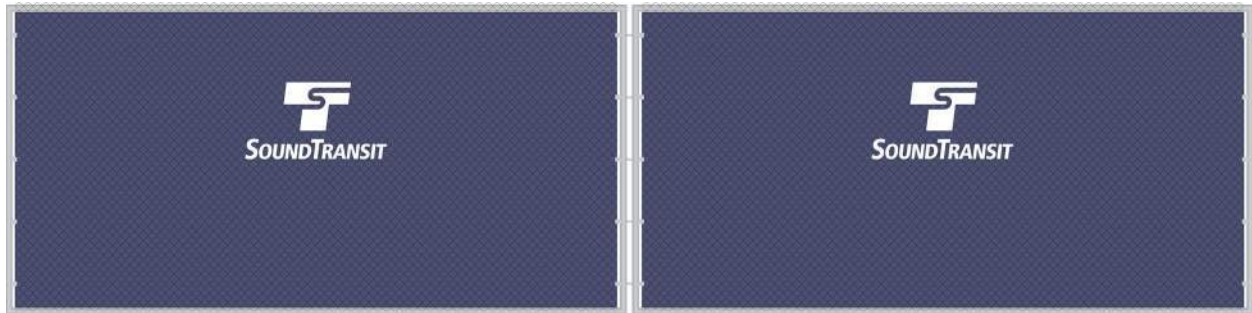
- Learn more about upcoming construction activities and activities.
- Speak with Sound Transit staff.
- Meet the contractor.

For more information contact Paige Carlsen at 206-388-5388 or paigec@soundtransit.org or visit soundtransit.org/updates.

Sign up to receive email updates at soundtransit.org/subscribe

SOUNDTRANSIT
 RISE THE WAVER

E.1 – Sound Transit logo applied to navy blue polyethylene screening – Logo is 33 by 18 inches



END OF EXHIBITS

SECTION 01 50 00 – ATTACHMENT A

TEMPORARY OFFICES FOR SOUND TRANSIT CONSTRUCTION MANAGEMENT

Contractor shall be responsible to provide, operate and maintain the temporary offices for Sound Transit Construction Management.

Temporary office locations shall be established at the following locations:

[]

Field office shall be completely furnished and ready for occupancy within 60 days of NTP.

Provide a []-story []-foot by []-foot field office trailer unit consisting of the following rooms/areas:

- a. [] offices with interior doors (approx. [] sq ft each)
- b. [] conference rooms (approx. [] sq ft each in rectangular shape). Include [] on 1st floor and [] on 2nd floor.
- c. Reception area
- d. [] partitioned cubicles (approx. [] sq ft each)
- e. [] meeting room (approx. [] sq ft)
- f. [] storage closet with shelves (approx. [] sq ft)
- g. Kitchen facilities (approx. [] sq ft) including double stainless steel sink, []-foot counter with storage above and below, with hot water and cold water supply, refrigerator, microwave, and trash bin.
- h. Copy machine room/area sized to accommodate floor standing copier/scanner, [qty] []-ft long side tables for sorting/collating.
- i. ADA-compliant access
- j. [] restrooms facilities ([] men's and [] women's or [] unisex) sized to accommodate one flush toilet each, toilet paper dispensers, toilet seat dispensers, and coat hook. The restrooms shall be integrated within the office facility, outfitted with sink, base cabinet, hot and cold water supply, mirrored medicine cabinet, paper towel dispenser, door hooks, and exhaust fans.
- k. [] ADA compliant shower facilities for men and women with hot and cold water supplies, non-slip flooring, soap dish, shower curtain or door and an adjustable shower head. Shower facilities shall have an abutting dressing area with privacy curtain, bench, clothes hook, towel hooks, and overhead cupboard for temporary storage.
- l. [] mud rooms (men's/women's) with locker facilities for [] people (men's) and [] people (women's).
- m. []-foot by []-foot lighted supply room with lockable door and floor-to-ceiling independently framed metal shelving with a minimum depth of [] inches along the perimeter, Shelving units to be secured to the walls.

Not Used

- n. File area adequate to contain [] lateral file cabinets, each having [qty] []-inch high drawers on rails and one lift-up door with fixed shelf. Room shall have center table adequately sized for sorting and binding of plans and Submittal drawings. Overall cabinet dimensions for each cabinet shall be approximately [] inches deep, [] inches wide and [] inches high. Each cabinet shall be lockable using a 9250 Ember Chrome Lock or approved equal.
- o. A separately acclimatized Computer Server/Network closet (approx. [] sq ft)
- p. ADA-compliant access to first floor
- q. [] entrance and at least one separate emergency exit: Contractor shall comply with local code requirements for all additional emergency exiting requirements.
- r. Exterior stairway to second floor entrances

Furnish the field office trailer unit with the following:

- a. Each office shall include one desk with side return (30 inches by 60 inches), ergonomic swivel chair with armrests, 6-foot tall bookcase, two-drawer lateral file cabinet, round table with two side chairs, one 3-foot by 4-foot whiteboard, waste basket, and coat hook.
- b. Each cubicle shall include one desk (each 30 inches by 60 inches) and one ergonomic swivel chair with armrests, one 2-drawer lateral file cabinet, one 3-foot by 4-foot whiteboard, one waste basket, and one coat hook.

Not Used

- d. The meeting room shall have a []-foot by []-foot meeting table, [] [stacking] [swivel] chairs, one side table, ceiling-mounted electrically operated projection screen, a 4-foot by []-foot whiteboard and a [large] waste basket. Conference table shall have electrical outlets and internet connections built into either end of table top w/cover.
- e. Reception/entry area shall have reception desk, ergonomic swivel chair with armrests, two stack chairs, 3-foot by 4-foot whiteboard, one two-drawer lateral file cabinet, a tack board (approximately 3 feet by 4 feet), and a coat rack.
- f. Kitchen shall include one round table and four stacking chairs.
- g. File room must have centrally located plan/file sorting table approximately 36 inches by 60 inches and one small side table to store a standard stapler, heavy duty stapler, and electric three-hole punch.
- h. Storage room shall include four shelves, 24 inches by 36 inches in dimension.
- i. Two-drawer lateral file cabinets shall each have two 12-inch high drawers on rails. Overall cabinet dimensions for each cabinet shall be approximately 18 inches deep, 42 inches wide, and 28 inches high. Each cabinet shall be lockable using a 9250 Ember Chrome Lock or approved equal.
- j. One each, 4-drawer lateral file cabinets will each have four 12-inch high drawers on rails. Overall cabinet dimensions for each cabinet shall be approximately 18 inches deep, 42 inches wide, and 52 inches high. Each cabinet shall be lockable using a 9250 Ember Chrome Lock or approved equal.

- k. Entry area shall have a 3-foot by 4-foot whiteboard, a tack board (approximately 3 feet by 4 feet), and a coat rack.
- l. Keypad locks on all doors to the field office.
- m. First aid kit for 20 people, replenished by the Contractor as needed.
- n. Fire extinguishers, tested and re-pressurized by the Contractor as required.

Provide utilities, power, telephone, and parking facilities to the field offices for the exclusive use of Sound Transit. The field offices shall be situated in the work area at locations shown on the Contract Drawings. They shall be maintained and serviced by the Contractor as hereinafter specified until the Acceptance of the Contract or as otherwise permitted by Sound Transit, whichever occurs sooner.

Construction Requirements, Systems, and Materials: Obtain and pay all costs for hauling, building, and connection permits. The field offices shall be substantially constructed and satisfactory to Sound Transit. All materials shall be good commercial quality. Provide field offices having at a minimum the following features and facilities specified or as agreed with the Resident Engineer:

Exterior and interior surfaces, other than factory finished, painted with two coats of an approved paint of a color or colors approved by Sound Transit. No painting will be required on aluminum or stainless steel surfaces.

Interior walls and ceilings paneled with finished plywood or gypsum wallboard of not less than 1/2-inch thickness, or other suitable material.

Floors covered with finished floor material, such as vinyl composition or sheet vinyl flooring. Floors shall be constructed with a minimum live load of 40 pounds per square foot.

Lighting shall furnish a minimum of 100 foot-candles at desk height uniformly in all areas.

Duplex electrical receptacles around interior walls at approximately 10-foot spacing

Specific electrical requirements to enable Sound Transit to provide copy machines and scanners: Provide one 20 amp dedicated circuit with 20 amp plug for [] Sound Transit-provided copy machines.

A multiple-zoned and automatically controlled heating/cooling system as needed to allow for climate control of separate offices and common areas

Electrical utility connections

Metal stairs at all doorways to the mobile unit and pedestrian access ramps: Meeting the requirements of "Persons with Disabilities (Equal Opportunities, Protection of Rights & Full Participation) Act"

Adequate access from public streets shall be provided to the field offices, together with space for parking [10] cars. The access roadway and parking area shall be graded for drainage and surfaced with gravel, concrete, or pavement in an approved manner. Surfaces shall be maintained until the Acceptance of the Contract or as otherwise permitted by Sound Transit, whichever occurs sooner.

Utility service connection sizes and locations shown on the Contract Drawings are approximate. Final locations and sizes of all required utility service connections shall be the Contractor's responsibility.

Flush-toilets, washing facilities, and hook-ups to sewer and water utilities: Bathrooms shall comply with ADA Accessibility requirements.

Tie down field offices to meet state and local wind and seismic construction criteria.

Exterior hose bib with boot scrape

Telecommunication connections for telephones and computers: Consisting of two 2-inch underground conduits extending from street services to the server closet.

Internet and telecom receptacles pre-wired from the computer server/network closet around interior walls and floors that correspond to the desk requirements outlined herein

Intrusion alarm, security bars at windows as needed, and call-up security system.

[] standing hanging plan/shop drawing rack

Windows furnished with [vinyl blinds, insect screens, other requirements, as needed]

Recycling and garbage receptacles and pickup service

Provide maintenance and service throughout the specified period as follows:

Repairing and daily cleaning of the field offices, parking and access areas. Cleaning service shall include providing paper towels and hand soap in kitchen(s) and toilet tissue, paper towels and hand soap in restrooms.

The furnishing of all utilities excluding telephone and network service

Provide security measures and area protection as required with Contract requirements

Bottled water and water dispenser with hot and cold water

Assume operations and maintenance of the temporary offices for Sound Transit Construction Management from the [] Contractor at Substantial Completion of the [] Contract. Maintain and service as specified herein until the Substantial Completion of this Contract or as otherwise permitted by Sound Transit, whichever occurs sooner..

Be responsible for operations and maintenance of the temporary offices for Sound Transit Construction Management. Maintain and service as specified herein until Substantial Completion of this Contract or as otherwise permitted by Sound Transit, whichever occurs sooner.

Sound Transit will provide the following:

Installation of the telephone and computer network

Telephone and internet service

Printers, copiers, scanners, and fax machines

Office/desktop consumable supplies for Sound Transit and Construction Management Consultant staff.

Additional requirements as indicated on Contract Drawings

Field offices shall become the property of Sound Transit upon Acceptance.

Field offices shall remain the property of the Contractor upon Acceptance.

SECTION 01 50 00 – ATTACHMENT B

TEMPORARY WATER SERVICE

Contractor shall be responsible for installation, operations and maintenance of the temporary water service(s).

[] will only allow [] domestic meter and [] fire service connection(s) to serve the Sound Transit project Site. Obtain temporary service connections from [] for their work.

For the duration that the [] Contractor and [] Contractor both occupy the Site, the [] Contractor may purchase water from and connect to the [] Contractor's construction water system. The [] Contractor will provide sub-meters for the [] Contractor's connections and bill the [] Contractor for water used in accordance with the local public utility's current water use billing rates.

Once the [] Contractor completes construction, the [] Contractor will retire its service meters with [] and then the [] Contractor shall coordinate directly with [] to obtain service from the existing meters.

SECTION 01 55 26

TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies temporary traffic control.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
 - 1. [Authority Having Jurisdiction]
 - a. City of Seattle Traffic Control Manual for In-Street Work
 - b. City of Seattle Standard Specifications for Road, Bridge and Municipal Construction
 - c. City of Seattle Standard Plans for Municipal Construction
 - 2. Washington State Department of Transportation (WSDOT)
 - a. WSDOT Standard Specifications for Road, Bridge and Municipal Construction
 - b. WSDOT Standard Plans, M21-01
 - c. WSDOT Design Manual, M22-01
 - d. WSDOT Work Zone Traffic Control Guidelines, M55-44
 - 3. U. S. Department of Transportation, Federal Highway Administration (FHWA)
 - a. Manual on Uniform Traffic Control Devices (MUTCD)
 - b. FHWA Final Rule on 23 CFR 630 Subpart J, 2004
 - 4. United States Access Board
 - a. Public Right of Way Accessibility Guidelines (PROWAG)
 - b. ADA Accessibility Guideline (ADAAG)
 - 5. American Traffic Safety Services Association (ATSSA)
 - a. ATSSA Quality Guidelines for Work Zone Traffic Control Devices
 - b.

1.03 SUBMITTALS

- A. Traffic Control Plan: In accordance with these documents, WSDOT Standard Specifications, or the authorities having jurisdictions (AHJ)'s Standard Specifications

1. The Traffic Control Plan shall provide description of all devices and management to be used during working and non-working periods. Include durations (days and times) of control plans. Plans shall be submitted for approval per Contractor's approved Submittal Log, so as to allow review and approval by Sound Transit and the Authorities Having Jurisdiction prior to the implementation of the plans.

- B. Qualifications for Traffic Control Manager (TCM) and Traffic Control Supervisor (TCS)

1.04 QUALITY ASSURANCE

- A. Qualifications for the Traffic Control Manager: As specified in WSDOT Standard Specifications Section 1-10.2(1)A.
- B. Qualifications for the Traffic Control Supervisor: As specified in WSDOT Standard Specifications Section 1-10.2(1)B.
- C. The TCS and the TCM shall have valid certificates as "Traffic Control Supervisors" as issued by the Evergreen Safety Council, The Northwest Laborers-Employers Training Trust, The American Traffic Safety Services Association, or approved equal.

PART 2 - PRODUCTS

2.01 TRAFFIC CONTROL DEVICES

- A. Provide or construct all traffic control devices, including temporary concrete barriers and temporary construction fencing, in conformance with applicable jurisdiction specifications and requirements. Include descriptions of traffic control devices in the Traffic Control Plan. The condition of signs and traffic control devices shall be new or "acceptable" as defined in the ATSSA Quality Guidelines for Work Zone Traffic Control Devices, and will be accepted based on a visual inspection by the Traffic Control Supervisor.

PART 3 - EXECUTION

3.01 GENERAL CONSTRUCTION

- A. For temporary traffic control of streets, roadways, and pedestrian and bicycle facilities that are to be owned or maintained by the AHJ, perform work described in this Section in conformance with the applicable requirements of that jurisdiction.
- B. Work with the Resident Engineer and the responsible jurisdiction to coordinate all necessary signal changes if required by the traffic control plan. Traffic signals shall only be countermanded by a uniformed police officer.
- C. Identify the use of flaggers and Police staff for traffic control in the Traffic Control Plan and obtain prior approval from the Resident Engineer. Employ flaggers whenever trucks enter onto a city street, including at all vehicle access gates to the construction work Site, to prevent conflicts with vehicles, cyclists, and pedestrians. Minimize roadway, lane, and sidewalk closures. Limit lane and roadway closures to non-peak traffic flow hours or other hours as determined by the AHJ. Travel lanes, parking lanes, and sidewalks outside of the construction wall shall be reopened when no construction activities are occurring.
- D. When sidewalks or bike paths are closed temporarily, provide alternate detour paths complying with ADA accessibility. In the case of temporarily closed bike lanes or paths, provide signing next to the lane or path and ahead of the work alerting bicyclists to the change. Parking lanes may be used for this purpose if a transition between the existing top of curb and the roadway is accessible. Include proposed design, including pedestrian

and bicycle detour and wayfinding signage, and business access signs and devices with the Traffic Control Plan. If the temporary walkway is to remain in place during non-working hours, clearly describe, in a separate section/chapter of the Traffic Control Plan, the traffic control devices to be in place during this period. Obtain all applicable permits for parking lane use and sidewalk closures.

- E. Maintain open access for all businesses at all times during construction, including large delivery vehicles. Sound Transit will work with property owners and businesses to understand access requirements.
- F. Do not close sidewalks on opposite sides of the roadway at the same time.
- G. Coordinate work activities with affected transit agencies, including temporary relocation or closure of bus stops and posting of informative signs (by others). See Special Conditions.
- H. Coordinate street closures, lane closures, and other in-street work activities including haul routes with Fire Departments and other emergency responders, post offices, major private delivery services, school districts, and solid waste collection operators.
- I. Obtain prior approval from local jurisdictions, [or WSDOT, and transit agencies] for closing or partial closing of all streets, sidewalks, or bike routes, as applicable. Give the required advance notice of all full and partial street closures after approval of the traffic control plan to all agencies providing emergency services, including without limitation, police, fire, and ambulance services. Include, at the least, the dates and times of commencement and completion of work, names of streets or location of sidewalks and alleys to be closed or partially closed, and schedule of operations and routes of detours where applicable.
- J. Ensure that reliable emergency access is maintained to avoid delays in response times.
- K. When the Work involves use of public ways, follow standard construction safety measures, which include but are not limited to, installing advance warning signs and high visibility construction barriers, providing necessary flaggers as required by the local authorities, and installing and maintaining means of reasonable access to all fire hydrants, parking garages, and other property.
- L. During nighttime work hours, use lighted or reflective signage to direct drivers, pedestrians, and bicyclists through work zones, and direct truck drivers to truck haul routes. Cover all conflicting signage.
- M. Obtain approvals from all jurisdictions if detours pass through multiple jurisdictions.
- N. Obtain all permits required for short-term and long-term, on-street parking displacements.

3.02 TRAFFIC CONTROL MANAGEMENT

- A. Before beginning work on the project, designate individual(s) to perform the duties of TCM and TCS, as described in Article 1.04 herein.
- B. Identify an alternate TCM and TCS that can assume the duties of the assigned or primary TCM and TCS in case of that person's inability to perform. Alternates will be adequately trained and certified to the same degree as the primary TCM and TCS.
- C. Maintain 24-hour telephone numbers at which the TCM and TCS can be contacted and be available at the Resident Engineer's request at other than normal working hours. Supply the TCM and TCS with appropriate personnel, equipment, and materials to correct any deficiency in the traffic control system at any time.

- D. Patrol the traffic control area daily and reset all disturbed signs and traffic control devices.
- E. Remove or cover signs and other traffic control devices during periods when they are not necessary.

END OF SECTION

SECTION 01 56 39

TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for:
1. Developing a Landscape Protection Plan approved by the Resident Engineer for all Trees and Landscape Requiring Protection, and all associated tree and plant protection elements that are in place at the beginning of the Contract prior to commencement of construction activity.
 2. Furnishing all labor, materials, equipment, supplies, and operations as required to install and maintain tree and plant protection as indicated and as required by the approved Landscape Protection Plan.
 3. Maintaining newly installed tree and landscape protection elements, including, but not limited to, fencing, woodchip mulch, landscape fabric, cabling, and signage.
 4. Areas for Tree and Plant Protection, as shown on the Drawings, include properties under the jurisdiction of the City of [Seattle], and Washington State Department of Transportation. Standards of each authority having jurisdiction must be met or exceeded.

1.02 REFERENCES

- A. This Section incorporates by reference the following documents:
1. [City of Seattle]
 - a. Standard Plans for Road, Bridge and Municipal Construction.
 - b. Standard Plans 132a, 132b, and 133.
 2. Council of Tree and Landscape Appraisers:
 - a. *Guide for Establishing Values of Trees and Other Plants*, issued by the Council of Tree and Landscape Appraisers.
 3. Washington State Department of Transportation
 - a. Standard Specifications for Road, Bridge and Municipal Construction 2012.

1.03 DEFINITIONS

- A. [COS: City of Seattle]

- B. Critical Root Zone (CRZ): An area surrounding the tree trunk which is equal to 1 foot radius for every 1 inch diameter of diameter of tree at breast height (DBH), measured from the center of the tree.
- C. DBH: Diameter of a tree at breast height, as measured 4-1/2 feet above the root flare.
- D. Dripline: The area on the ground beneath the outer edge of the tree's canopy.
- E. Exceptional Tree: A tree or group of trees that because of its unique historical, ecological, or aesthetic value constitutes an important community resource, and is determined as such by the Director of the City of [Seattle Department of Planning and Development (DPD) according to standards and procedures promulgated by DPD].
- F. Inner Critical Root Zone: An area surrounding the tree trunk which is equal to 6-inch radius for every 1 inch diameter of diameter of tree at breast height (DBH), measured from the center of the tree.
- G. ISA: International Society of Arboriculture.
- H. Landscape Requiring Protection: All existing vegetation with the soil that supports its growth as identified in the Contract Documents to remain and be protected.
- I. Project Arborist: An International Society of Arboriculture (ISA) certified arborist on the Contractor or Subcontractor's team, and approved by Sound Transit.
- J. Root Flare: The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- K. Trees Requiring Protection: All existing trees to remain and be protected as identified in the Contract Documents and the Tree Protection Plan, including areas of tree critical root zones of trees within the vicinity of the Project Site which may be affected by construction.
- L. WSDOT: Washington State Department of Transportation.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate with property owners having jurisdiction over Work Sites.

1.05 SUBMITTALS

- A. Tree and Landscape Protection Plan: Submit to the Resident Engineer 30 days prior to commencement of any construction activity. Include the following:
 - 1. Table of Contents
 - 2. A survey plan drawing with tree locations provided by a professional surveyor
 - 3. Final landscape protection locations and phasing plan drawing. Include fence locations and a schedule, if fence locations must change to accommodate other Site Work
 - 4. List and schedule of all intended landscape maintenance practices to be provided
 - 5. Tree labels including identification number as assigned

6. Each tree's number, botanical and common name, DBH, CRZ, and minimum tree value
 7. List of Exceptional Trees, if any
 8. The watering schedule for temporary watering. Indicate source of water, a reliable method of slow application, and duration for watering
 9. All Work activities within 50 feet of Trees and Landscape Requiring Protection
 10. Anticipated work methods for work within CRZ of all landscape to be protected
 11. Proposed tree and root avoidance techniques
 12. Documentation of Project Arborist's on-site confirmation or re-designation of the CRZ for each tree
- B. Photo Documentation, Tagging, and Inventory Reports: To be performed by Project Arborist prior to construction activities:
1. Photograph Trees and Landscape Requiring Protection immediately following Notice to Proceed and again after plants produce a full canopy of leaves if initial photographs are taken when plants are bare of leaves.
 2. Photo Document all Landscape Requiring Protection: Photograph trees from the cardinal directions (north, south, east, west). Label all photographs with:
 - a. Location of photograph
 - b. Tree tag number, unique for each tree
 - c. Direction from which the photograph was taken
 - d. Date photograph was taken
 3. Written inventory of Landscape Requiring Protection, confirming location, type, and size.
 4. Provide two (2) hard copies of photographic documentation and inventory and two (2) electronic copies to the Resident Engineer 30 Days prior to Work commencing on Site.
- C. If not listed herein, provide an appraisal by the Project Arborist for all Trees and Landscape Requiring Protection identified by the Contract Documents. The Project Arborist shall provide supplemental appraisal values for additional landscape or trees whose critical root zones may be affected by construction and therefore need to be protected. Base the appraisals upon the current *Guide for Establishing Value of Trees and Other Plants*.
- D. Qualifications of Project Arborist.
1. International Society for Arboriculture Certified Arborist in good standing.
 2. Minimum 5 years of experience in the field.
- E. Product Data:
1. Mycorrhizae fungal inoculant

2. Slow release fertilizer
 3. Landscape protection fencing
 4. Wood chip laboratory report
- F. Samples:
1. Landscape protection signage: One (1).
 2. Tree appraisal value signage: One (1).
 3. Cabling material: One foot length.
 4. Wood chips: One pound bag.
 5. Coir mat: One square foot.
- G. Compliance Reports: Submit observations and recommendations for each Site visit conducted by the Project Arborist.

1.06 PROJECT CONDITIONS

- A. The Resident Engineer may order the Work stopped if tree and landscape protection is not complete prior to Site Work, if unauthorized use of protected area is occurring, or if protection fencing is not restored within 24 hours of notice to do so.
- B. Tree Identification: In all correspondence regarding Trees and Landscape Requiring Protection and protection systems, refer to the location and specific tree number on the Contract Documents or as listed herein.
- C. Trees Requiring Protection: Use list of trees and data provided in the Landscape Protection Plan, not the Contract Drawings, as the information in the Landscape Protection Plan may be more current than the Contract Drawings.
- D. Exceptional Trees: Some surface impact locations include Exceptional Trees. Coordination and scheduling of tree protection measures is required with [City of Seattle Urban Forestry representatives]. Protection measures at these locations include, but are not limited to, fencing, special containment and handling of construction materials, selective pruning and tying-back of tree limbs, scheduling of work in seasons amenable to manipulation of tree limbs, avoidance of inner critical root zones, and special excavation and drilling practices.

1.07 WARRANTY

- A. Warranty for replacement plants as follows:
 1. Replace plants which, in the opinion of the Resident Engineer, are in unhealthy or unsightly condition, or that have lost their natural shape due to dead branches, excessive pruning, or excessive defoliation.
 2. Be responsible for maintenance of all replacement plants during the Warranty Period. Inspect the plant materials to ensure that the areas are receiving proper care. Sound Transit will provide periodic reviews and notify of areas needing attention.
 3. Replace unacceptable plants no later than the next succeeding planting season.

4. Replace unacceptable plants in accordance with original specification. Cost is considered to be included in the Contract.
5. Any plant that is 25 percent or more dead or disfigured is considered dead and must be replaced at no charge. Plants are considered disfigured when excessive dead wood has been removed or when the symmetry, typical habit of growth, or sculptural form has been impaired by the removal of dead wood.
6. The above warranty is applicable to any growing conditions through which plants of like kind could be expected to survive and any deformity or cause of death which could be attributed to, or affected by, the physiological conditions of the plant. The warranty would not apply to plant losses due to abnormal weather conditions such as floods, excessive wind damage, drought, severe freezing, or abnormal rain, as determined by the National Weather Service.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Protection Fencing

1. In accordance with the jurisdictional standards of the property owner for each Site.
2. If no standards exist, use chain-link fencing only.
 - a. Chain link fence materials including footings, posts, braces, and mesh to be used to form a 6 foot high enclosure.
 - b. Footings:
 - 1) Type 2: above ground precast concrete block type footings, 100 pounds minimum.
 - c. Posts: 1-1/2 inch steel pipe, minimum. Use with approval by Resident Engineer in areas where fence must cross existing paved surfaces or where indicated by Contract Drawings or Landscape Protection Plan.
 - d. Mesh: 2 inch by 2 inch 11 gauge chain link fabric, minimum.

B. Protection Signage:

1. Provide weather resistant, fluorescent green or yellow signs 48 inch by 48 inch with minimum of 3 inch high letters indicating the following:
 - a. Protection Warning: No Trespassing on the landscape or critical root zone of tree/trees without direct approval of Resident Engineer. Unauthorized activities or Work within the critical root zone of trees will result in a fine of \$1,500, or the appraised landscape value, whichever is greater.
 - b. Botanical/common names
 - c. Appraised value of tree and landscape

C. Cabling: Meet landscape industry standards for permanent cabling of trees.

- D. Tree tags: Race-track shaped aluminum tags engraved with individual tree numbers as indicated on Contract Documents.
- E. Water: Potable water supplied by the Contractor.
- F. Mycorrhizae Fungal Inoculant: Mycogrow Gel, manufactured by Fungi Perfecti (Olympia, WA) or Mycorrhizal Landscape Inoculant, manufactured by BioOrganics (Santa Monica, CA), or approved equal to meet jurisdictional requirements.
- G. Slow Release Fertilizer: Osmocote 14-14-14 slow release pellets, Osmocote Controlled Release Fertilizer 13-13-13, Sierra Controlled Release Fertilizer Plus Minors 17-6-12, or approved equal to meet jurisdictional requirements.
- H. Wood Chips: Chipped wood mulch or hog fuel, which has composted for a minimum of 1 year, or approved equal to meet jurisdictional requirements. Submit mulch to laboratory to be checked for undesirable pathogens. Submit laboratory report.
- I. Coir Mat: Geocoir@DeKoWe 400 by Belton Industries, Koir Mat 400 by Nedia Enterprises, or approved equal to meet jurisdictional requirements.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to construction activity:
 - 1. Submit a Landscape Protection Plan for review and acceptance which meets or exceeds the standards of the jurisdiction of the property owner.
 - 2. Verify adequacy of the extent of Landscape Requiring Protection as defined in the Contract Documents.
 - a. Project Arborist to review Contract Documents and periphery of Site for any additional landscape or trees whose critical root zones may be affected by construction and therefore need to be protected.
 - 3. Tag trees with designated numbers.
 - 4. Post Protection Signage for all Trees and Landscape Requiring Protection as specified herein.
 - 5. Protect Landscape in accordance with approved Landscape Protection Plan.
 - 6. Protect soil and roots within the CRZ of all Trees and Landscape Requiring Protection with coir mat under wood chips.
 - 7. If required, root prune within the CRZ three (3) months prior to commencement of construction activity under the guidance of the Project Arborist..
 - 8. Install landscape protection fencing.
 - 9. Protection begins prior to commencement of construction activities and continues to Acceptance.

3.02 INSTALLATION

A. Landscape protection fencing:

1. Fencing in accordance with jurisdictional requirements specified herein: Install fence on above ground precast concrete block type footings in locations as indicated in approved Landscape Protection Plan.
2. Install fencing and wood chips to protect Trees or Landscape Requiring Protection from construction activities unless otherwise approved by Resident Engineer.
3. If construction activities are expected adjacent or near Trees or Landscape Requiring Protection, install chain-link fencing in accordance with jurisdictional standards for the duration of construction activities.
4. Do not compact soil or use heavy equipment in the CRZ when installing protective fencing installation.
5. Provide diagonal bracing to vertical posts at corners of enclosures and wherever needed to ensure rigidity of the fencing.
6. Install chain link fabric tight to grade at the bottom edge, and stretched uniformly between posts. Install top of fabric 6 feet above grade, minimum.
7. Install fabric to form continuous fencing. Attach fabric to posts 12 inches on center with 11 gauge wire ties securely fastened, or with bolted ring clips, and to top rail not over 3 feet on center.
8. Attach orange flag strips 12 inches long at 3 feet on center along the fence, 5 feet above grade.
9. Provide one (1) locked gate at each fenced area.

B. Protection signage:

1. Affix one (1) protection sign to each Tree Requiring Protection using a method accepted by the Project Arborist.
2. Affix one (1) protection sign to the Protection Fence around each area of Landscape Requiring Protection.

C. Coir Mat and Wood Chips:

1. Protect soil and roots within the CRZ of all Trees Requiring Protection with a coir mat under a layer of 4 inches of wood chips. Provide a 12 inch radius clear zone at the base of each tree.
2. When understory plants such as lawn or shrubs are within the CRZ of Trees Requiring Protection, or in areas of Landscape Requiring Protection, provide coir mat and wood chips when directed to do so by the Resident Engineer as needed to protect soils and roots from any work taking place within the fencing.
3. In areas of Tree or Landscape Requiring Protection with understory landscape, provide additional wood chips when directed to do so by the Resident Engineer as needed to protect soils and roots from any work taking place within the fencing.

3.03 PROTECTION

A. Project Arborist to:

1. Monitor Work within CRZ of all Trees Requiring Protection including all excavation, demolition, and all resurfacing of sidewalks and road beds. See Section 31 11 00, Clearing and Grubbing, for excavation requirements for trees.
2. Monitor and be on Site at time of removal of existing hardscape within CRZs to avoid root damage. As hardscape is removed, identify existing subgrade and assist in establishing final grade or new pavement subgrade by providing direction for root protection. Where new pavement is planned, direct the cutting of roots 6 inches clear of planned paving edge.
3. Monitor maintenance of all Landscape Requiring Protection to ensure it is in a healthy condition. Report deficiencies or concerns to the Resident Engineer immediately. Implement adjustments to the protection plan as directed by the Resident Engineer as needed during the course of the Work.
4. Immediately report deficiencies or concerns to the Resident Engineer.
5. Implement adjustments to Landscape Protection Plan and list of Landscape Requiring Protection as needed and as accepted by the Resident Engineer.
6. Perform on-Site review as needed during construction for activities that are adjacent to or affecting all Trees and Landscape Requiring Protection.
7. Provide Compliance Reports of maintenance Site visits and field inspections to review and respond to Site conditions and health status of all Trees and Landscape Requiring Protection including:
 - a. Construction activities affecting protected areas.
 - b. Status of protection elements.
 - c. Maintenance and watering conditions.

B. Tree and Landscape Protection:

1. Refer to Section 31 11 00, Clearing and Grubbing. Protect landscape in accordance with Tree and Landscape Protection Plan.
2. Coordinate with Project Arborist regarding areas requiring special attention as identified and specified on the Contract Documents.
3. Locate tree protection in accordance with the Contract Documents and approved Tree and Landscape Protection Plan unless otherwise directed by Project Arborist.
4. Within the CRZ, hand-excavate to prevent tears and breaks in root surfaces. Leave roots larger than 2 inches in diameter intact and undamaged. If roots greater than 2 inches in diameter must be removed, consult with Project Arborist prior to removal.
5. Use air spade to excavate within CRZs, as identified on Tree and Landscape Protection Plan. Cut roots cleanly with a diamond blade when roots are exposed or disturbed by Work activities.

6. At all times when roots are exposed, keep roots moist with moist soil, wet mulch, and burlap, or approved equal.
 7. In utility trenches, place utility conduit either under roots by tunneling, or over roots using adequate sand bedding. Verify with the Resident Engineer that the bedding is adequate.
 8. Carefully plan and execute operations to avoid damaging plants and soils. Coordinate with Project Arborist and Resident Engineer on requirements specified herein.
 9. Protect against cutting, breaking or skinning of roots, skinning or bruising of bark, compaction of soils in root zones, and breaking of branches.
 10. Perform heavy equipment work from locations, angles, and directions that minimize compaction to tree or shrub roots and soils.
 11. Under the supervision of the Project Arborist and Resident Engineer, tie back flexible limbs and overhead branches which may, in the opinion of the Project Arborist and Resident Engineer, be damaged by the passage or activity of equipment. Anticipate limbs that may be in the way of necessary equipment to avoid limb damage and provide a remedy before Work occurs. Do not remove tree limbs without the prior written acceptance of the Resident Engineer.
- C. Use of area within protective fences and within the CRZ of all Trees and Landscape Requiring Protection:
1. Do not store materials potentially harmful to plants within 20 feet of outside limit of protected areas. Potentially harmful materials include, but are not limited to: petroleum products, cement and concrete materials, cement additives, lime, paint coatings, waterproofing agents, form coatings, detergents, acids, and cleaning agents.
 2. Do not alter grades within the required protective fence area.
 3. Control soil moisture within the protected area. Prevent flooding of the soil, and protect root areas from leachate, cement, oil, fuel and lubricating oil, and all contaminants.
 4. Notify the Resident Engineer and Project Arborist 48 hours in advance of the need to move protection fence.
 5. Upon relocation of fence, continue all other protection efforts and maintenance of Trees and Landscape Requiring Protection in accordance with the Trees and Landscape Protection Plan.

3.04 MAINTENANCE

A. Tree and Landscape Maintenance:

1. Perform all pruning, thinning, and other maintenance under the direction of the Project Arborist.
2. Prune as necessary for safety, to promote the health of the tree, and to allow clearance for construction within the tree dripline or CRZ (whichever is greater) of all Trees Requiring Protection. Do not move protection fences prior to consultation with the Project Arborist and acceptance by the Resident Engineer.

3. Fertilize and inoculate all Trees and Landscape Requiring Protection throughout the life of the Contract. Under direction of Project Arborist, aerate and inject mycorrhizae and slow release fertilizer into the root zone surrounding all Trees and Landscape Requiring Protection. Perform injection with a soil injection needle attached to an applicator or other means per direction of Project Arborist.
4. Water Trees and Landscape Requiring Protection at least once per week from June 21 to September 21 or as directed by the Project Arborist. Ensure continuous uninterrupted water supply to each area of protection throughout the duration of the Contract. Do not allow water to run off or cause erosion at any time during watering.
5. Maintain woodchips at the specified depth. Should the depth of wood chips measure less than the specified depth at any time; replenish to attain the specified depth. Do not allow the depth of wood chips in the CRZ to measure less than the specified depth for more than 48 hours.
6. Notify the Resident Engineer and Project Arborist 48 hours prior to all Work to be performed within the CRZ of any Tree Requiring Protection.
7. Maintain all Trees and Landscape Requiring Protection in a healthy and flourishing condition until Acceptance of the Contract, as directed by the Project Arborist. Prevent damage to roots, trunks, and crown protected plants, and provide maintenance required to guarantee their health. Protection and maintenance responsibilities include, but are not limited to:
 - a. Replacing damaged protection fencing regardless of cause, including acts of vandalism.
 - b. Aerating compacted soils.
 - c. Controlling surface runoff.
 - d. Expertly pruning and treating damaged roots.
 - e. Replacing wood chips within protection areas to maintain the specified depth of chips.
 - f. Keeping all exposed roots moist in accordance with Article 3.03.B.6 herein.
 - g. Keeping mulch away from base of trunk as specified herein.
 - h. Performing work under the direction of the Project Arborist.
 - i. Remove weeds in planting areas throughout the duration of the Contract.

B. Fence Maintenance

1. Maintain fences in good condition at the specified location until Acceptance of Site operations, except where directed otherwise in writing by the Resident Engineer. Immediately repair fencing when damaged, regardless of cause of damage.
2. Protection fencing may be removed temporarily for specific construction operations only under review and acceptance of the Project Arborist and the Resident Engineer.

3.05 REPAIR/RESTORATION OF DAMAGED LANDSCAPING

- A. Repair and restore landscaping damage inflicted by construction outside the construction areas and designated access routes, which include damaged landscape removal, complete soil preparation, approved planting, and adequate irrigation to establish the replaced landscape.
- B. Damages for loss or injury to Tree or Landscape Requiring Protection including loss or injury as a result of vandalism or construction activities:
 - 1. In the event of damage or loss to Trees or Landscape Requiring Protection due to failure to protect and maintain said tree, pay Sound Transit as liquidated damages a sum equal to:
 - a. The value of each lost tree or plant, as determined by the Project Arborist's confirmed and accepted appraisal values as noted in Article 1.05C herein.
 - b. The cost to remove and dispose of said tree or plant, and
 - c. An additional \$1,500 per damaged or lost tree or plant in compensation for the efforts of Sound Transit in administering and overseeing the replacement.
 - 2. In the event of injuries to the crown, trunk, branches or root system of Trees Requiring Protection that are the result of the Contract's failure to protect and maintain such tree, the Resident Engineer may elect to retain the tree and hold the Contractor liable for compensation.
 - 3. Completely remove and dispose of plants requiring protection that are killed or irreparably damaged due to vandalism, natural acts, diseases, or failure to protect or maintain plant. Remove and dispose of the plant, including the entire stump and roots to a depth of 2 feet below finish grade.
 - 4. Replace at Resident Engineer's direction trees or plants lost or, in the opinion of the Resident Engineer, irreparably damaged as a result of failure to protect or to adequately maintain. Replacement conditions will not apply to plant losses due to abnormal weather conditions such as floods, excessive wind damage, drought, severe freezing, or abnormal rain, as determined by the National Weather Service. Trees, which fail to fully foliate in the spring following completion of construction operations, may be presumed to have been lost due to construction operations.
- C. Locate and install replacement trees and plants in accordance with jurisdictional standards and by direction of the Resident Engineer. The Resident Engineer may require lost trees be replaced in areas other than in their original location.
- D. Pruning of Damaged Trees
 - 1. Sterilize equipment with alcohol prior and during trimming and pruning operation.
 - 2. Under the direction of the Project Arborist, cleanly cut off broken limbs and branches to the nearest crotch in accordance with good horticultural practice. Cut limbs and branches greater than 1/2 inch in diameter. Carry out all pruning of damaged trees to the approval of the Resident Engineer.
 - 3. Maintain Trees and Landscape Requiring Protection in as good of a condition at the completion of the Work as at the commencement of the Work. If such a

condition does not exist at the completion of the Work, provide corrective measures at the direction of the Project Arborist.

4. Pay for all costs for the repair of damage to trunks or major limbs 3 inches in diameter or over requiring, in the opinion of the Resident Engineer, the attention of a professional tree surgeon. Consider all costs incurred in the protection of Trees Requiring Protection incidental to the Contract.

3.06 Fence Removal

- A. Remove protection fencing and wood chips only at Resident Engineer's direction. Fence removal is subject to all protection measures for Trees and Landscape Requiring Protection being satisfied as stated in this Section and stated in the Tree and Landscape Protection Plan prepared by the Project Arborist.

3.07 Schedule

TREES TO BE PROTECTED

NUMBER	Botanical Name	Common Name	SIZE (DBH)	CRZ Dia	VALUE

END OF SECTION

SECTION 01 57 00.10

SMALL PROJECT ENVIRONMENTAL PROTECTIONS AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the requirements and performance specifications for mitigating construction impacts to the environment, including air, land, and waters of the United States or Waters of the State, through best management practices and controls for project typically less than 1 acre and where Hazardous or Contaminated Substances are not present.
- B. The Contractor is wholly responsible for control of all water, including groundwater, stormwater, process water, entering onto, originating, and exiting the construction site or staging areas.
- C. The Contractor is responsible for coordination with Authorities Having Jurisdiction (AHJ) associated with this Contract. This includes defining, confirming, verifying, and complying with current requirements for construction stormwater permitting, operations, and wetland mitigation.
- D. This work must apply to all areas associated with contract work including, but not limited to the following work areas:
 - 1. Job site
 - 2. Equipment and material storage areas
 - 3. Staging and laydown areas
 - 4. Stockpiles

1.02 STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents:
 - 1. Washington State
 - a. Department of Ecology (Ecology) Stormwater Management Manual for Western Washington (SMMWW)
 - b. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction
 - 2. Municipality:
 - a. Applicable municipality noxious weed list
 - b. Applicable municipality environmentally sensitive areas ordinance
 - c. Applicable municipality fire code and amendments
 - d. Applicable municipality standard specifications for road, bridge, and municipal construction

- e. Applicable municipality standard plans
- f. Applicable municipality stormwater manual
- g. Applicable municipality stormwater code
- 3. Industrial Waste Rules and Regulations
 - a. King County Code (KCC)-KCC 28.84.060
 - b. Applicable municipality industrial waste rules and regulations

1.03 DEFINITIONS

- A. BMPs (Best Management Practices): The activities, practices, maintenance procedures, and other physical, structural, or managerial actions used during construction to prevent or reduce the pollution of groundwater and surface waters of the State: BMP types are specified by number in the current version of the Ecology Western Washington Stormwater Manual
- B. Bulk Fuels: Fuels in quantities greater than 250 gallons including, but not limited to, motor oil, gasoline, kerosene, diesel fuel, hydraulic oil, and other products that are derived from the refining of crude oil and are contained in drums or tanks (above ground or buried)
- C. CESCL: Certified Erosion and Sediment Control Leads for Western Washington, Ecology: BMP C160
- D. CSEMS: Construction Site Environmental Management Supervisor
- E. Critical Area: Any wetland, stream, buffer, steep slope, wildlife area or zone, or other designated area: these areas or zones are defined by the local, state, or federal laws and requirements
- F. ECAR: Environmental Corrective Action Request
- G. Fugitive Dust: As defined by the Puget Sound Clean Air Agency
- H. Noncompliance Event (or Events): Noncompliance exists where surface water, groundwater, or sanitary sewer water discharged to groundwater exceeds allowable discharge limits
- I. Process Water: Discharges including, but not limited to:
 - 1. Truck and wheel wash water, equipment wash water, petroleum or chemically contaminated water, non-contact cooling water, and chlorinated water
 - 2. Water used for sawcutting, grinding, and coring of asphalt and concrete
 - 3. Site water in contact with and chemically affected by site conditions which cannot be treated on site to meet surface water discharge criteria.
- J. Surface Water:
 - 1. Federal waters and surface waters of the State
 - 2. Wetlands, jurisdictional ditches, and open drainage channels
 - 3. Municipality's stormwater system
- K. Surface Waters of the State: Lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington

- L. SMMWW (Stormwater Management Manual for Western Washington): The technical manual published by Ecology for use by local governments, that contains the description of and design criteria for BMPs to prevent, control, or treat pollutants in stormwater
- M. SPCC: Spill Prevention, Control, and Countermeasures Plan
- N. TESC (Temporary Erosion and Sedimentation Control): Planning, managing, controlling, mitigating, recording, and reporting discharge of stormwater from construction sites
- O. Turbidity: The clarity of water, expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter
- P. Vegetation Management Plan: A plan describing how trees, vegetation, or landscaping will be protected throughout the duration of the project: this must include invasive species management within the project area following Sound Transit's Integrated Pest Management Plan and pesticide use request forms (Exhibit A), which can be downloaded at N:\Environmental Affairs & Sustainability\EAS OPERATIONS\IPM_Sustainable Landscaping\Herbicide Requests\Pesticide Use Request Form\ST Pesticide Use Request Form_6-2020.docx
- Q. Wet Season: October 1 through April 30
- R. Dry Season: May 1 through September 30

1.04 ADMINISTRATION

- A. Coordinate with property owners having jurisdiction over work sites.
- B. A TESC preconstruction meeting, including a site inspection with the AHJs and Sound Transit, is required before ground disturbance including, staging, grubbing, clearing, or grading begins.

1.05 SUBMITTALS & TRANSMITTALS

- A. Submittals
 - 1. Air Pollution Control Plan: Submit 21 days prior to disturbing soil, staging, land clearing, grubbing, grading, or any demolition activities
 - 2. Critical Area Protection Plan: Submit 30 days prior to disturbing soil, staging, land clearing, grubbing, grading, or any demolition activities
 - 3. Discharge to Sanitary Sewer/Combined Sewer Plan
 - 4. Qualifications for Construction Site Environmental Management Supervisor
 - 5. Spill Prevention, Control, and Countermeasures Plan: Submit 21 days prior to disturbing soil, land clearing, grubbing, grading, or any demolition activities
 - 6. Spill Report Form (Exhibit B) Submit within 24 hours of a reported spill
 - 7. TESC Plan: Submit 21 days prior to disturbing soil, including staging, clearing, grubbing, grading, or any related demolition activities
 - 8. Trucking Plan: For any construction-impacted stormwater or wastewater being transported off site for disposal at an Ecology permitted facility
 - 9. Vegetation Management Plan: Submit 21 days prior to disturbing soil, staging, land clearing, grubbing, grading, or any demolition activities

B. Transmittals

1. Citations issued in conjunction with this Contract: Within 24 hours of issuance
2. Manufacturer data and test results for all erosion control products
3. Qualifications of the CESCL
4. Spill Report Form (Exhibit B) Within 24 hours of a reported spill.
5. Spill Report Log (Exhibit C) Update within 7 days of a reported spill
6. TESC BMP Inspection Log: Transmit copies to the Resident Engineer weekly for the previous week's inspections

1.06 QUALITY ASSURANCE

A. Implement the Construction TESC Plan, Spill Control Plan, and Air Pollution Control Plan, including design of and all revisions to, and the construction, maintenance, replacement, and modification of the erosion and sedimentation control facilities, until Acceptance of current work.

B. Employ Construction Site Environmental Management Supervisor (CSEMS with the following responsibilities:

1. Be currently certified as a CESCL in accordance with BMP C160 requirements
2. Have a minimum five years of experience being responsible for construction, site erosion and sediment control regulatory requirements, BMPs, TESC Plan development, and stormwater monitoring: at least three years of the experience must be on projects in the Pacific Northwest
3. Approved by the Resident Engineer to implement, manage and enforce compliance with the requirements
4. Be solely responsible for developing, maintaining, and modifying the TESC Plan, SPCC Plan, and Pollution Control Plan for the life of the Contract and ensuring compliance with all requirements
5. Have the authority to act on behalf of the Contractor and be available on call 24 hours per day for the duration of the Contract Must arrive on-site within 12 hours of being called.
6. Be available to accompany Sound Transit's representative or Ecology personnel during weekly inspections of all BMPs, at a time designated by the Resident Engineer.
7. Ensure that all TESC BMPs are installed, inspected, maintained, and modified as conditions change for the duration of the Contract

C. TESC BMP daily logs and inspection reports must be updated by the CESCL on a daily basis and must include the following:

1. Inspection date/time
2. Weather information; general conditions during inspection and amount of precipitation since the last inspection
3. A summary or list of all BMPs implemented, including observations of all erosion and sediment control structures or practices. Note locations of BMPs inspected,

needing maintenance, or failing to operate as designed and locations where additional or different BMPs are required

4. General comments and notes, including a brief description of BMP repairs, maintenance, or installations made as a result of the inspection
5. Visually Inspect all stormwater discharges for turbidity and oily sheen

1.07 SEQUENCING AND SCHEDULING

- A. CSEMS will review construction sequencing and staging to identify BMPs that will be implemented.
- B. Prior to installing the BMPs for perimeter controls (such as silt fence), the construction limits must be surveyed by the Contractor and verified by Sound Transit to ensure they are consistent with the permitted impact areas according to the permits.
 1. Work must not begin until the perimeter controls have been approved and are installed.
 2. Sequence the Work per the BMP tables defined in the current SMMWW. Construction sequencing that limits staging, land clearing, provides timely installation of erosion and sedimentation controls, and restores protective cover quickly can significantly reduce the erosion potential of a site. Consider scheduling the project to disturb only small portions of the site at any one time. Complete grading as soon as possible. Immediately stabilize the disturbed portion before grading the next portion. Practice staged seeding to revegetate cut and fill slopes as the work progresses.
 3. Provide permanent stabilization following completion of Work in an area.

PART 2 - PRODUCTS

2.01 SUMMARY

- A. The materials, BMPs, and methods listed below are some of the materials, BMPs, and methods that the Contractor may choose to use in meeting the requirements of this Section. A complete list of approved BMPs can be found in Volume II of the current SMMWW. Unless otherwise noted, the materials, BMPs, and methods listed are not required and the list of materials, BMPs, and methods is not intended to be all-inclusive. The Contractor may choose other materials, BMPs, and methods, provided they meet the applicable city, state, and federal permits and requirements.
- B. Materials
 1. General: Materials used for erosion and sediment control BMPs must be in accordance with the materials specified in the SMMWW Volume II, Chapter 4
 2. Stabilized Construction Entrance: In accordance with SMMWW Volume II, BMP C105
 3. Inlet Protection (required): Specifically designed for catch basins and inlets, made of a filter fabric insert with a 48- by 36-inch adapter skirt, retrieval strap, overflow bypass, and sediment accumulator: inlet protection by Silt Sack, Streamguard, or approved equal
 4. Take proper measures to prevent tracking of soil, aggregate, mud, or other debris onto public and private streets, drives, parking lots, and sidewalks: measures may

include, but are not limited to, closed loop wheel wash, washing tires, covering on-site haul roads and muddy areas with clean, dry sand, gravel, or trap rock, and maintaining clean haul routes on paved surfaces

PART 3 - EXECUTION

3.01 GENERAL

- A. Conduct operations in a manner to minimize pollution of the environment surrounding the area of work by every means practicable.
- B. Maintain the site in a neat and orderly manner to avoid environmental degradation.
- C. Initial site construction activities include:
 - 1. Mobilization and staging of equipment and materials
 - 2. Temporary security fence installation
 - 3. Sediment control BMPs (such as sediment ponds, storage tanks, traps, filters, silt fences, stabilized construction entrances, wheel wash) constructed as one of the first steps for staging and grading
 - 4. Marking and managing critical areas and vegetation to be protected
- D. Major staging and grading is allowed except as needed for BMP installation and construction
- E. Maintain proper security at all times to discourage and avoid vandalism

3.02 PLAN REQUIREMENTS

- A. TESC PLAN
 - 1. Include a copy of the qualifications of the individual preparing the TESC Plan with the TESC Plan.
 - 2. The TESC Plan consists of two parts: a narrative and drawings. Both parts must contain information specific to the construction site.
 - 3. The TESC Plan must show how construction stormwater and erosion control BMPs will be installed, maintained, and removed, and be updated throughout the project as construction activities, conditions and BMPs are adjusted, and will include, at a minimum, the following specific information:
 - a. Construction details of all chemical handling and storage areas, vehicle and equipment storage areas, wheel washes, stabilized construction entrances, perimeter control BMPs, collection sump-pumps, conveyance pipes, ditches, berms, culvert pipes, storage ponds, storage tanks, filters, and basin outfalls
 - b. Location of all facilities that are designed to treat sediment-laden runoff prior to discharge to the existing drainage system: in lieu of providing on-site treatment of the runoff, the runoff may be collected and hauled off site for treatment using an approved method
 - c. A conceptual TESC Plan may be included in the Contract Drawings "for information only": revise the TESC Plan to reflect the actual means and methods proposed, including alternative BMPs

- d. A description of the inspection and monitoring plan for TESC BMPs over the life of the Contract pertaining to the inspection of all BMPs daily. The log of TESC all inspection reports must be transmitted to the Resident Engineer weekly, for the previous week
- e. A narrative describing the training program for educating all personnel, including subcontractors, on environmental protection: this training may be added to existing weekly meetings (such as safety meetings): emphasize issues such as sensitive receptors, spill prevention, chemical handling and storage, emergency response, stormwater control facilities inspections, proper dewatering techniques, and concrete handling
- f. The name, telephone number, cell phone number(s), email address, and business address of the designated CSEMS and all Contractor personnel responsible for erosion and sediment control, updated as needed

B. AIR POLLUTION CONTROL PLAN

- 1. Describe the approach the project will take for air pollution control
- 2. Describe the BMPs that will be used so that no emissions are visible beyond the site boundaries.
- 3. Include the requirement for the prevention of odors that interfere with the public, including limiting use of chemical products and keeping construction equipment in good mechanical condition to minimize exhaust emissions.
- 4. The application of any chemical dust suppressants must be approved by the Resident Engineer prior to use.
- 5. Notify the Resident Engineer of any complaints.

C. SPILL PREVENTION PLAN

- 1. Developed in accordance with 40 CFR 112 with supplemental requirements as indicated below.
- 2. Include the following:
 - a. CSEMS is responsible for implementing the plan if a spill occurs
 - b. Training protocol to be conducted and documented monthly to discuss the status and requirements of the spill prevention plan and the current locations of the spill kits on site
 - c. On a drawing for each site: staging, storage areas, maintenance, spill kits, and refueling locations and their relationship to drainage pathways, waterways, and other sensitive areas
 - d. Daily inspection of spill kits to ensure that adequate spill response, containment, and cleanup materials are available: document inspection results on daily TESC inspection reports
 - e. Daily Inspection of fuel hoses, lubrication equipment, hydraulically operated equipment, oil drums, and other equipment and facilities. Inspect for drips, leaks, or signs of damage, and maintain and store properly to prevent spills.
 - f. Fuel Storage:

- 1) All portable fuel storage tanks between 6 and 250 gallons, except for vehicle and equipment petroleum fluid tanks, must:
 - a) Be specifically engineered to meet or exceed all national environmental and hazardous waste regulations
 - b) Have a secondary shell providing up to 110 percent containment
 - c) Be accompanied by a spill kit and fire extinguisher staged within 15 feet
- 2) Portable fuel storage containers less than 6 gallons
 - a) Must be stored within secondary containment equivalent to 110 percent of the container's capacity
 - b) Must be placed and stored in secondary containment at all times, unless being actively used to fill equipment
 - c) Must be refilled in secondary containment
- g. Spill Response Procedures: Report all spills that occur regardless of the size or type of the spill to the Resident Engineer on a Spill Report Form.
- h. Collect at least one soil sample following removal of spilled Hazardous Substance and complete appropriate chemical analysis based on Hazardous Substance spilled to confirm removal of Contaminated Substances is sufficient in accordance with Model Toxics Control Act.
- i. The provided Spill Report Form (Exhibit B) must be used, and modifications to the form must be approved by the Resident Engineer.
- j. Maintain a Spill Report Log (Exhibit C) for all spills.
- k. If the spill of a hazardous substance could reach surface waters, the following agencies must be notified: National Response Center (1-800-424-8802) or WWW.NRC.USG.MIL/INDEX.HTM. Notify the regional WA Department of Ecology office. Timely notification is required.
- l. The SPCC Plan must include provisions, requirements, and details to stop any spills at the source and install protective covers over storm drain grates. If spill is flammable, call 911 and dispose of as directed by the local Fire Marshal.
- m. Ensure employees who respond to spills are trained to a level of competence as defined in the SPCC Plan.

3.03 IMPLEMENTATION

A. Preparation

1. Clearly flag the boundaries of the staging/clearing and construction limits as indicated on the Contract Drawings or as designated by the Resident Engineer by a continuous length of fencing or screening wall prior to construction.
2. During the construction period at each site, no disturbance beyond the staging/clearing and construction limits is permitted without prior authorization from the Resident Engineer.

3. Maintain the staging/clearing and construction limits for the duration of construction.
- B. Temporary spoil piles:
1. Cover the piles after 2 days of inactivity during the wet period and 7 days of inactivity during the dry period.
 2. Place all excavated material not hauled directly from the construction site in a temporary spoil pile surrounded and contained using ecology blocks or equivalent.
 3. Control water seepage and runoff and direct to water treatment system. Treatment of seepage and runoff from piles is required prior to discharge from site.
 - a. Stockpile on Site sufficient BMP materials and supplies to protect the entire site.
 - b. Protect catch basin inlets to the permanent storm drainage system from sediment influx by use of filter fabric, catch basin insert, or similar filtering materials and methods in accordance with the SMMWW.
- C. BMP Installation
1. Installation practices for erosion and sediment control BMPs must be in accordance with the most recent SMMWW, Volume II and manufacturer's specifications.
 2. Inlet Protection: Protect catch basin inlets to the permanent storm drainage system from sediment influx by use of catch basin insert or similar filtering materials and methods per SMMWW.
- D. Maintenance
1. Before and while erosion is occurring, make modifications to the erosion control system to mitigate the erosion and its effects.
 2. General maintenance activities:
 - a. Repair or replace damaged or missing items immediately.
 - b. Use water sprinkling, temporary enclosures, and other methods to minimize dust and dirt migration. Prevent runoff from all water used for dust control from entering the storm sewer system.
 - c. Immediately stabilize, with the approved BMP methods (such as seeding, mulching, and plastic covering), all areas of exposed soils that will not be disturbed for 2 days during the wet season or 7 days during the dry season.
 - d. Address all areas needing BMP measures that do not require immediate attention within 7 days of notification from the Resident Engineer or CSEMS.
 - e. At a minimum, inspect all TESC BMPs daily and after significant rain events (0.5 inch or greater). Repair as necessary to meet requirements of the SMMWW
 - f. Maintain and repair all TESC practices as needed to ensure continued performance of their intended function.

- g. Operate and maintain BMPs in accordance with the SMMWW Volume II and following operational and maintenance requirements:
- h. Prevent sediments from being flushed to the downstream system during cleaning.
- i. Remove sediment, trash, and debris from catch basin grate surfaces when blocking more than 20 percent of the grate surface.
- j. Clean or replace inlet and catch basin filter socks when sediment fills one-third of the available storage or the fill limits recommended by the manufacturer have been met. Immediately clear or replace clogged fabric.
- k. Immediately remove and properly dispose of all sediment introduced into a catch basin.
- l. Handle and dispose of cleaning waste material and demolition debris in a manner that does not cause contamination of water. If the area is swept with a pick-up sweeper, the material must be hauled out of the area to an appropriate disposal site.
- m. Update the TESC with site-specific construction work plans as necessary to reflect construction work area limit changes, the construction activities accompanying these changes, and all changes to BMPs or stormwater handling and treatment systems.

E. Completion of Construction

Remove all TESC measures within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Remove and dispose of trapped sediment in an approved site or stabilize trapped sediment on site. Permanently stabilize disturbed soil areas resulting from removal.

F. System Compliance

- 1. The Resident Engineer, CSEMS, and regulatory agencies will determine the effectiveness of the TESC system. If the Contractor's ESC system is found to be not conforming to specifications, laws, permit conditions or BMPs, the Contractor or the Resident Engineer, or both, will issue an ECAR. See Exhibit D.
- 2. If the erosion control system is determined to be ineffective by the Resident Engineer or regulatory agencies, the Resident Engineer may issue an ECAR. (See Exhibit D.)
- 3. Upon issuance of an ECAR, the Contractor must investigate and describe the root cause of the noncompliance and provide remedial correction for the nonconforming item(s). Immediately correct damaged, inadequate, or ineffective TESC BMPs.
- 4. Refusal to modify and upgrade the erosion control system as required within 5 days of notice from the Resident Engineer may result in the work being completed by a third party and the cost of the work being withheld from payments due.
- 5. Continued noncompliance with the erosion control requirements and water quality requirements may result in stoppage of work and monetary fines.
- 6. In the event that the Washington State Department of Ecology or other AHJs issues a Notice of Violation, Notice of Noncompliance, Corrections Required, or other enforcement action, the Resident Engineer may issue a stop work order for

all construction activities until it has been determined to the satisfaction of the Resident Engineer and Ecology or the other AHJs that the project is in compliance. The Resident Engineer may require the Contractor to send additional staff to stormwater construction BMPs field training, as provided by the Associated General Contractors, or other Sound-Transit-approved training before construction activities can resume. The Contractor must not be entitled to additional time or compensation arising from any measures required or taken under this clause. The Contractor must be responsible for, and pay all costs associated with, work stoppages, mitigation of the triggering event(s), and training.

7. The contractor must be solely responsible for all damages, fines, levies, judgments, stop work orders, and related schedule impacts incurred as a result of Contractor, subcontractor, or supplier failure to comply with the requirements of this Section. Said damages, fines, levies, or judgments will be deducted from payments due. The Contractor will not be entitled to additional contract time arising from any measures required or taken under this clause.

END OF SECTION

EXHIBITS

Exhibit A: Pesticide Use Request Form

Exhibit B: Spill Report Form

Exhibit C: Spill Report Log

Exhibit D: Environmental Corrective Action Request (ECAR)

SECTION 01 57 00.10 – EXHIBIT A

PESTICIDE USE REQUEST FORM



Date of Request:		Date of Revised Request:	
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Sound Transit Pesticide Use Request Form

Requestors Information

Full Name:			
Last		First	M.I.
Phone:	()	E-mail Address:	
Company Name:			
Street Address:			
City		State	ZIP Code
Pesticide License No:	Expiration Date:	List Endorsements	
Are non-licensed applicators proposed?		YES* ☐	NO ☐

*If yes, direct supervision by the licensed applicator is required. The applicator must follow all current regulations. The licensed applicator must be physically present at the application site. The person making the application is always in voice and visual contact with the licensed applicator during the application.

Describe why pesticide control is needed. List methods already used (e.g., grubbing, mowing, mulching, etc.) and why those methods are not appropriate or did not work.

Date of Proposed Use:		End Date of Proposed Use:	
-----------------------	--	---------------------------	--

(Attach map and provide approximate area to be treated (i.e., square feet or acres))

Targeted Species: (i.e., noxious weed species, insect name, fungi name, other)	
Targeted Species:	
Targeted Species:	
Targeted Species:	
Targeted Species:	
When is the best time for control? (month, season, time of day)	

Does this request coincide with the best control time?	YES ☐	NO ☐
--	------------------------------	-----------------------------

If no, describe why not:

Provide methods and/or criteria for application (e.g. mow, spray, air temperature thresholds, precipitation criteria, etc.):
--

Proposed Pesticide Product(s) Information (Attach additional sheets as needed)			
Trade Name:		EPA Registration No:	
Active Ingredients:		Inert Ingredients (if listed) include surfactants:	
Pesticide Label (attach):	YES ☐ NO ☐	Material Type: (e.g., gas, liquid, powder, solid, etc.)	
Will pesticide be applied in a critical area or buffer?	YES ☐ NO ☐	If yes, what kind? (e.g., wetland, stream, buffer)	
Will pesticide be applied in or over water	YES ☐ NO ☐	If yes, is an NPDES Permit required?	YES ☐ NO ☐
Is the site located in a Pesticide Use Limitation Area (PULA)	YES ☐ NO ☐	Is a Bulletin required?	YES ☐ NO ☐

SECTION 01 57 00.10 – EXHIBIT B

SPILL REPORT FORM

Please complete this form and retain on file. Page ____ of ____

Person reporting spill:	Telephone number:
Date of spill:	Time of spill:
Time / Date spill was cleaned up:	
Source of Spill – Equipment:	
Material type:	
Material quantity:	
Weather conditions:	
Spill reported to: ☐ Police/Fire Dept. (911) ☐ Ecology – (425) 649-7000 ☐ Sound Transit – Resident Engineer ☐ National Response Center 800-424-8802 ☐ Spill Response Subcontractor ☐ Other: _____	
Cause(s) and effect(s) of spill:	
Spill containment and clean up procedures initiated:	
Description of spill location and surroundings:	
Corrective actions taken to prevent future incident:	
Agency(s) on the scene:	
Report completed by:	
Printed Name: _____	
Signature: _____	
Title:	Date:

**SECTION 01 57 00.10 – EXHIBIT C
SPILL REPORT LOG**

SPILL REPORT LOG

PLEASE COMPLETE THIS FORM AND RETAIN ON FILE.

DATE	LOCATION	TYPE OF MATERIAL & QUANTITY	SOURCE	CAUSE	CORRECTIVE AND/OR PREVENTIVE ACTION(S) TAKEN	RECORDER'S INITIALS

SECTION 01 57 00.10 – EXHIBIT D

ENVIRONMENTAL CORRECTIVE ACTION REQUEST (ECAR)



ENVIRONMENTAL CORRECTIVE ACTION REQUEST (ECAR)

Environmental Non-Conformance

1.01 THIS SECTION WILL BE COMPLETED BY THE ORIGINATOR ISSUING THE ECAR

1. Project Name:	2. ECAR Number:	3. Date ECAR Issued:	4. Originator/Organization:
5. ECAR Issued to:	6. Date of Environmental Non-Conformance:	7. ECAR Response Due Date: [within ten (10) working days after issue date]	
8. Location of Environmental Nonconformance:			
9. Contract Requirement(s):			
☐ Specification Section(s):			
☐ Permit and Condition Number:			
☐ Other (e.g. – Submittal, Drawing(s), etc.):			
10. Description of Non-Conformance [include photographs as appropriate, see below]:			
Is this a Recurring Non-Conformance [check one]: ☐ Yes ☐ No			
11. ECAR Originator's RE/Supervisor Signature:			
Printed Name: Signature: Date:			

1.02 THIS SECTION WILL BE COMPLETED BY THE INDIVIDUAL/ORGANIZATION RESPONSIBLE FOR RESPONDING TO THE ECAR	
12. Root Cause(s): [Describe why the Non-Conformance happened using the "five whys" methodology]:	
13. Corrective Action Taken to Prevent Recurrence [include where incorporated/documented – e.g., checklist, drawing, inspection, etc.]:	14. Corrective Action Implementation/ Effective Date:
15. Environmental Manager's concurrence that information above accurate and correct:	
_____ Printed Name: Signature: Date:	
This section will be completed by Originator issuing the ECAR	
16. Originator's signature indicating ECAR response has been satisfactorily addressed and closed, or rejected:	
☐ Accept ☐ Reject, brief description of why: _____ Printed Name: Signature: Date:	
<i>This section will be completed by Sound Transit Environmental Compliance Staff Reviewer</i>	
17. This ECAR response satisfactorily addresses the non-conformance.	
_____ Printed Name: Signature: Date:	

END OF EXHIBITS

SECTION 01 57 15

TEMPORARY CONSTRUCTION NOISE AND VIBRATION CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for complying with applicable noise regulations, and noise and vibration limits.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents.

- 1. American National Standards Institute (ANSI) / Acoustical Society of America (ASA)
 - a. ANSI/ASA S1.4 American National Standard Specification for Sound Level Meters
 - b. ANSI/ASA S2.4 American National Standard Method for Specifying the Characteristics of Auxiliary Analog Equipment for Shock and Vibration Measurements

1.03 DEFINITIONS

- A. Construction Site: For purpose of noise and vibration control requirements, the Construction Work Area limits. This includes Right-of-Way, property, and construction easements, used expressly for construction.
- B. Noise Level Measurements: A-weighted and "slow" response readings from instruments complying with TYPE 1 or TYPE 2 requirements of the ANSI/ASA S1.4.
- C. A-Weighted Noise Levels: Decibels (referenced to 20 micro-Pascal) as measured with A-weighting network of standard sound level meter, abbreviated dBA.
- D. Vibration Measurements: The use of a vibration transducer, amplifier, peak detector, and frequency band filters complying with ANSI/ASA S2.4.
- E. Vibration: Velocity in microinches per second. Vibration levels are expressed as velocity levels in Decibels referenced to one microinch per second, abbreviated VdB.
- F. Noise Sensitive Locations: Residential areas, institutions, hospitals, parks, and other locations so named herein.
- G. Maximum Sound Level L_{max} : The maximum recorded root mean square (RMS) A-weighted sound level for a given time interval or event.
- H. Equivalent Sound Level L_{eq} : The A-weighted level of a constant sound having the same energy content as the actual time-varying level during a specified interval. The L_{eq} is used to characterize complex, fluctuating sound levels with a single number. Typical intervals for L_{eq} are hourly, daily and annually.

- I. Vibration Monitoring: Monitoring used to determine if the equipment and methods used to complete the work cause vibrations that equal or exceed threshold values. The data gathered provide onsite feedback of the effects of specific operations and procedures.

1.04 SUBMITTALS

- A. Noise and Vibration Control Plan:
 - 1. Within 45 days of Notice to Proceed (NTP), prior to commencing work on the site, or as specified herein.
 - 2. Update and re-submit upon all major change in work schedule, construction methods, or equipment operations not included in the most recent Plan.
 - 3. Monitoring Plan:
 - a. Prepare and submit a scaled plan indicating noise and vibration measurement monitoring locations on a scaled plan.
 - b. Certificates of calibration for monitoring instruments, including updated certificates after repairs to instruments.
- B. Noise and Vibration Measurement Reports: Submit weekly. Include measurements taken during the previous week.
- C. Shop and Working Drawings, computations, material data and other criteria, for all noise abatement measures identified in the Noise and Vibration Control Plan.
- D. Qualifications of the Acoustic Specialist:
 - 1. Membership in at least one of the following recognized acoustical organizations:
 - a. Institute of Noise Control Engineering (INCE): INCE Member. INCE Associate Membership is insufficient.
 - b. Acoustical Society of America (ASA): Member. Student and Associate Memberships are insufficient.
 - c. National Council of Acoustical Consultants (NCAC): Employee of a NCAC Member Firm.
 - 2. Minimum 10 years of experience performing similar work.

1.05 RESPONSIBILITIES OF CONTRACTOR

- A. Perform Work within the permissible noise and vibration levels, work schedule limitations, and procedures provided for in this Section; the approved Noise Variance listed in Contract Documents; and applicable federal, state, county and local codes, regulations, and standards.
- B. Use equipment with effective noise-suppression devices and employ other noise control measures such as barriers and curtains necessary to protect the public.
- C. Schedule and conduct operations in a manner minimizes, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.
- D. Compliance with the requirements of this Section may require the use of equipment with special exhaust silencers or enclosures, and construction of temporary enclosures or

noise barriers around activities. Use haul routes and staging areas as shown on the Contract Drawings or if not shown as approved by the Resident Engineer, to minimize noise at residential and other sensitive receptor sites. Noise produced by elevated equipment, including crane pulleys and hoses, must be minimized.

1.06 NOISE AND VIBRATION CONTROL PLAN

- A. Prepared and certified by the Acoustic Specialist.
- B. Include the following requirements for construction activities that may occur at the construction site:
 - 1. Site Drawing - Prepare a scaled drawing of the construction site indicating the following:
 - a. Contract name and number
 - b. Contractor's name
 - c. Date and hours of work operation
 - d. Scale
 - e. Direction of North
 - f. Identify noise and vibration sensitive locations near the construction site
 - g. Construction equipment locations used, designated by the code letter used in Column (a) in Part A of the Noise Control Plan Form, Exhibit A.
 - h. Locations of the noise levels calculated for the nearest residential, commercial, and industrial areas as specified herein.
 - i. Locations and types of noise abatement measures that may be required to meet codes and regulations as indicated by the calculations.
 - 2. Equipment Inventory - Prepare an inventory of equipment used by providing the following information in the indicated columns of Noise Control Plan Form, Exhibit A.
 - a. Column (a) - Code letter in sketch to indicate position of equipment on site
 - b. Column (b) - Category or type of equipment
 - c. Column (c) - Equipment manufacturer and model, if known at the time of the Plan's preparation
 - d. Column (d) - Unique identifier (ID), such as registration number, if known at the time of the Plans preparation.
 - e. Column (e) - Equipment horsepower
 - f. Column (f) - Estimated noise level at 50 feet, obtained from either the manufacturer or from approved field noise measurements of same equipment
 - g. Column (g) - Estimated date of first use on site
 - h. Column (h) - Estimated date of last use on site

- i. Noise Calculations - Prepare calculations of L_{max} noise levels expected at the nearest residential and commercial property lines and identified noise-sensitive locations near the construction site, based on the equipment noise levels given in Part A of the Noise Control Plan Form. Determine the nearest property lines from the noise-sensitive locations. Make the calculations for locations where noise emitted by applicable equipment causes the greatest noise level for each type of land use, if necessary. Provide the results on Part B of the Noise Control Plan Form, Exhibit B, with calculations included below the results, and with the locations for the calculations indicated on the site sketch.
3. Summary of Required Abatement Measures, as necessary.
- a. Noise Abatement Measures - If the results of the noise calculations indicate that noise level limits are exceeded, identify proposed noise abatement measures, their anticipated effects (dBA reductions), and a schedule for their implementation. Re-calculate the noise levels at the nearest sensitive receptor location property lines that include the anticipated noise reduction effects and submit the results on Part B of the Noise Control Plan Form. Include, as backup documentation to Part B of the Noise Control Plan, drawings, sketches, and suitable calculations that demonstrate anticipated noise reduction benefits and that proposed structures or facilities comply with applicable building code requirements.
 - b. Noise Reduction Methods - To the extent required to meet the noise limits specified, indicate noise reduction measures to minimize construction noise emission levels.
 - c. Vibration Control – Provide measures that can be used to reduce vibrations in the event that level limits are exceeded. The measures include changes in construction techniques.

C. Monitoring Plan

1. Requirements

- a. In the event that the measured noise levels exceed the allowable limits as specified by the local jurisdiction, immediately notify the Resident Engineer and immediately implement additional specified Noise Abatement Measures. Where necessary terminate the construction activity responsible for the noise limits exceedance until the specified Abatement Measures can be implemented and compliance with the approved noise variance is achieved.
- b. In the event that the measured vibration levels exceed the allowable limits as specified by the local jurisdiction, immediately notify the Resident Engineer and immediately implement changes in construction techniques as specified in the Noise and Vibration Control Plan.

2. Monitoring Locations

- a. The noise and vibration monitoring locations are shown on the Contract Documents. The measurement sites shown represent the closest points to noise and vibration sensitive land uses to the construction equipment being operated. These locations may change during the Contract and the Resident Engineer will provide updates as required.

- b. Noise measurement to be taken at construction site boundaries and at nearby residential and commercial property lines as defined above.

PART 2 - PRODUCTS

2.01 NOISE CONTROL MATERIALS

- A. Noise control materials may be new or used. Used materials must be sound and free of damage and defects and are of a quality and condition to perform their designed function for the duration of construction of this Contract.

2.02 NOISE MEASUREMENT EQUIPMENT

- A. Perform noise measurements using installed sound monitoring stations approved by the local jurisdiction which are equipped with the following measurement and documentation devices:
 - 1. Sound level analyzer with the following capabilities:
 - a. Capable of measuring on both the A-Weighted and C-Weighted scales required by regulatory criteria and Noise Level Limits.
 - b. Complies with the criteria for a TYPE 1 (Precision) or TYPE 2 (General Purpose) Sound Level Meter as defined in the ANSI/ASA S1.4.
 - c. Continuous broadband logging on 1-second LAeq, LAmix and LAmin.
 - d. Continuous spectral logging of 1-second LAeq, LAmix and LAmin.
 - e. Sound recording and external equipment trigger capabilities in the event of a variance exceedance.
 - f. Sufficient internal memory for one (1) week of logged data and sound recordings.
 - 2. Free-field microphone housed in an environmental shroud providing protection from rain and wind conditions. The environmental shroud is capable of outdoor measurements for at least one (1) year without service or replacement.
- B. Calibrate sound level analyzer, microphones, and calibrators for certified laboratory conformance at least once during the Contract. Submit a current certificate of conformance to the Resident Engineer before using the sound level meter and submit updated certificates following subsequent calibrations upon the completion of repairs to the instrument.

2.03 VIBRATION MONITORING EQUIPMENT

- A. Provide portable seismographs for monitoring the velocities of ground vibrations resulting from construction activities. The seismograph has the following minimum features:
 - 1. Seismic Velocity range: 0.005 to 10 inches per second with an accuracy of within 3 percent of the measured peak particle velocity or better at frequencies between 1 Hertz and 250 Hertz, and with a resolution of 0.005 inch per second or less.
 - 2. Frequency response (within 3 dBA points): 1 to 250 Hertz.
 - 3. Multi channel for vibration monitoring.

4. Two power sources: internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibration continuously for up to 30 days.
 5. Capable of internal dynamic calibration.
 6. Direct writing to printer and capability to transfer data from memory to a laptop computer or compact disc (CD). Instruments must be capable of producing strip chart recordings of readings on site within one (1) hour of obtaining the readings. Provide computer software to perform analysis, produce reports of continuous monitoring, and to perform zero-crossing frequency analyses of waveform data. Ensure that all reports and analyses are capable of output to a laptop computer or CD.
 7. Self-triggering wave form capture mode that provides the following information: plot of wave forms, peak particle velocities, frequencies of peaks.
 8. Continuous monitoring mode must be capable of recording single-component peak particle velocities, and frequency of peaks with an interval of 1 minute or less.
- B. Provide all recommended ancillary equipment as recommended by the manufacturer for a complete and functional system.

PART 3 - EXECUTION

3.01 NOISE LEVEL LIMITS

- A. Do not operate noise generating construction equipment at the construction site prior to final approval of the Noise and Vibration Control Plan or formal noise variance activation by the local jurisdiction..
- B. Do not exceed the maximum permissible sound levels as authorized by the local jurisdiction's noise code for nighttime construction hours.
- C. Sound created by impact types of construction equipment, including but not limited to pavement breakers, jackhammers, sandblasting tools, or other types of equipment or devices that create impulse noise or impact noise or are used as impact equipment, as measured at the nearest property line or monitoring point, may exceed the maximum permissible sound levels as approved by the local jurisdiction.
- D. For operation of construction equipment that could exceed allowable noise limits during nighttime hours established by the local jurisdiction, the Contractor must obtain the appropriate noise variance from the local jurisdiction having authority. During these hours, meet the performance criteria as approved by Sound Transit and the local jurisdiction.
- E. The noise limits in 3.01A through 3.01C are for equipment on construction sites, including but not limited to crawlers, tractors, dozers, rotary drills, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, and pneumatic-powered equipment
- F. The noise levels should be measured at the nearest reasonable sensitive noise receptor.

3.02 VIBRATION LEVEL LIMITS

- A. Measures applied to limit noise levels may in some cases limit vibration levels also. Measures specified above for noise levels are applicable.
- B. For all areas, conduct construction activities so that vibration levels at the nearest affected building monitoring points do not exceed root-mean-square (rms) unweighted vibration velocity levels in vertical direction over a frequency range of one to 100 Hertz as listed in Table 3.
- C. Vibration levels at buildings affected by construction operations refer to vertical direction vibration on ground surface or building floor.
- D. Installation of Vibration Monitors:
 - 1. For monitoring in the vicinity of nearby structures or utilities, locate vibration sensors on the ground surface near the structures or utilities. Install geophones level and firmly mount on the surface slab of concrete or asphalt, or firmly anchor in undisturbed soil. Orient geophones towards the construction activity.
 - 2. For monitoring on structures, install wall mount kit to attach geophones to structure face or columns. Mount geophones level and orient towards the construction activity.
 - 3. See Section 31 09 00, Geotechnical Instrumentation and Monitoring of Earthwork, for other installation, monitoring, and reporting requirements.
- E. Conduct daily measurements of vibration during peak vibration generating construction activities. Any activities that may produce vibration levels above values shown in Table 3 whenever a structure is located near the construction activity are subject to vibration monitoring. Peak vibration generating construction activities are limited in the design.

3.03 CONSTRUCTION METHODS - EQUIPMENT

- A. Where possible, use concrete crushers or pavement saws rather than hoe rams for tasks such as concrete deck removal and retaining wall demolition.
- B. Ensure that pneumatic impact tools and equipment used at the construction site have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise ordinance limitations.
- C. Construction equipment, both stationary and mobile, should be of recent manufacture and incorporate effective noise-suppression design, including features such as shrouds, baffles, and mufflers or as recommended by the manufacturer. Locate stationary equipment that generates noise away from sensitive receptors and shield with a noise-attenuating barrier or shroud.
- D. Line or cover storage bins and chutes with sound-deadening material. Ensure all vehicles engaged in loading on-site have lined truck beds.
- E. Provide mufflers or shield paneling for equipment, including internal combustion engines, recommended by manufacturers thereof.
- F. Blasting, impact pile driving, vibratory hammers for pile casing installation, vibratory sheet installation and vibratory rollers are prohibited from use during those hours established by the local jurisdiction.

- G. As required to meet the noise limits specified in this Section, use alternative procedures of construction and selection of proper combination of techniques that generate least overall noise and vibration. Such alternative procedures include the following:
1. Use electric welders powered from utility main lines instead of internal combustion powered generators/welders.
 2. Mix concrete off-site instead of on-site.
 3. Employ prefabricated structures instead of assembling on-site.
 4. Drilled pile installation methods.
- H. Use construction equipment manufactured or modified to dampen noise and vibration emissions, such as:
1. Electric instead of diesel-powered equipment
 2. Hydraulic tools instead of pneumatic impact tools
 3. Electric instead of air- or gasoline-driven saws

3.04 CONSTRUCTION METHODS - OPERATIONS

- A. Operate equipment and in particular slurry wall installation equipment and cranes so as to minimize banging, clattering, buzzing, and other annoying types of noises, especially near residential areas.
- B. To the extent feasible, configure the construction site in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations and nearby buildings.
- C. In no case are above restrictions limiting the responsibility for compliance with applicable federal, state and local safety ordinances and regulations and other Sections of these Contract Specifications.
- D. Maximize physical separation, as far as practicable, between noise generators and noise receptors. Separation includes following measures:
1. Provide enclosures for stationary items of equipment and barriers around particularly noisy areas on site.
 2. Locate stationary equipment to minimize noise and vibration impact on community, subject to verification by the Resident Engineer.
- E. Minimize noise-intrusive impacts during most noise sensitive hours.
1. Plan noisier operations during times of highest ambient noise levels.
 2. Keep noise levels relatively uniform; avoid excessive and impulse noises.
 3. Turn off idling equipment and vehicles.
 4. Phase in start-up and shut-down of site equipment.
 5. Avoid simultaneous activities that both generate high noise levels.
 6. Conduct truck loading, unloading and hauling operations so noise and vibration are kept to a minimum.

7. Whenever feasible, do not operate trucks on streets that pass by schools during school hours.
 8. Limit the time that steel decking or plates for street decking or covering excavated areas are in use.
 9. Grade surface irregularities on construction sites to minimize the generation of impact noise and ground vibrations by passing vehicles.
- F. Use warning broadband backup alarms on all equipment in operation at the site, at all times.
 - G. Limit the use of annunciators or public address systems, except for emergency notifications.

3.05 CONSTRUCTION METHODS – NOISE ABATEMENT MEASURES

- A. Install noise abatement measures in locations specified in the Noise Control Plan adjacent to equipment as required to meet the noise limits specified.

3.06 NOISE AND VIBRATION MEASUREMENT PROCEDURES

- A. Noise Measurement Procedure
 1. Field calibrate the sound level analyzer using an acoustic calibrator, according to the manufacturer's specifications, before each measurement.
 2. Except as otherwise indicated, perform measurements using the A-weighting network and the SLOW response of the sound level meter.
 3. Measure impulsive or impact noises using the C-Weighting network and the FAST response of the sound level meter.
 4. Fit the measurement microphone with an appropriate windscreen at the location of the sensitive receptor at least four to six feet away from the nearest reflective surface.
 5. Take noise measurements at the nearest property line and agreed noise sensitive locations at least once each week and after a change in construction activity or construction location. Determine the duration of noise measurements based on the type of construction activity, the length of the activity, and whether it is continuous or intermittent. Measurement periods: a minimum of 20 minutes.
 6. Ensure that construction noise measurements coincide with periods of maximum noise-generating construction activity, and take measurements during the construction phase or activity that has the greatest potential to create annoyance or to exceed applicable noise regulations and restrictions.
 7. If, in the estimation of the person performing the measurements, outside noise sources contribute significantly to the measured noise level, repeat the measurements with the same outside source contributions when construction is inactive to determine the background noise level.
 8. Submit noise data to the Resident Engineer on a weekly basis using the Noise Measurements Report Form provided in Exhibit C. Note the type of measurement (for example, baseline, on-going construction) on the form.
 9. Clearly identify proposed monitoring locations that must be approved by the local jurisdiction and sketch on the back of the Noise Measurements Report Form,

Exhibit C, along with the locations of and distances from any agreed sensitive noise receptor or location.

10. Identify construction equipment operating and characterize the sound being generated during the monitoring period and the locations sketched on the back of the Noise Measurements Report Form, along with the locations and distances to any agreed noise sensitive location.

B. Vibration Measurement Procedures

1. Field calibrate the vibration monitoring equipment, according to the manufacturer's specifications, before each measurement.
2. Take vibration measurements at sensitive locations as indicated herein and on the Contract Drawings at least once each week and after a change in construction activity or construction location. Measurement periods: a minimum of 20 minutes.
3. Submit vibration data to the Resident Engineer on a weekly basis using a Contractor-generated form. Note the type of measurement (for example baseline, on-going construction) on the form.
4. Clearly identify monitoring locations and sketch on the back of the vibration report form.
5. Identify construction equipment operating during the monitoring period and the locations sketched on the back of the vibration report form.

TABLE 1 - CONSTRUCTION VIBRATION LIMITS

Vibration Type (Permissible Duration)	Peak Particle Velocity (in/sec)
Sustained (≥ 1 hr/day)	0.04
Transient (< 1 hr/day)	0.12
Transient (< 10 min/day)	0.4

END OF SECTION

EXHIBITS

Exhibit A: Quarterly Noise Control Plan – Part A

Exhibit B: Quarterly Noise Control Plan – Part B

Exhibit C: Noise Measurements Report Form

APPENDICES

Appendix A: Other Noise Sensitive Locations

SECTION 01 57 15 – EXHIBIT A
QUARTERLY NOISE CONTROL PLAN – PART A

CONSTRUCTION ACTIVITIES AT EACH CONSTRUCTION SITE
(DUPLICATE AS NEEDED)

Contract No.: _____ Contract Name:

Contractor: _____

Site: _____ Date:

Resubmit every three months

(ATTACH SITE SKETCH)

PART A: EQUIPMENT INVENTORY

	Equipment				Noise Level	Date	Date
Code	Categor y	Model	ID No.	HP	At 50 Feet	Begin	End
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)

SECTION 01 57 15 – EXHIBIT B
QUARTERLY NOISE CONTROL PLAN FORM - PART B

(DUPLICATE AS NEEDED)

Contract No.: _____ Contract Name:

Contractor: _____ Site:

Date: _____ Land Use:

Resubmit every three months.

PART B: CALCULATED CONSTRUCTION NOISE LEVELS AT NEAREST RESIDENTIAL AND COMMERCIAL RECEIVERS FOR EACH CONSTRUCTION ACTIVITY

Nearest Noise Sensitive Receivers	Calculated Sound Pressure Level (dBA)*

* EQUIPMENT USED FOR EACH CONSTRUCTION ACTIVITY IS TAKEN FROM PART A OF THE NOISE CONTROL PLAN

NOISE ABATEMENT MEASURES

ANTICIPATED EFFECTS

CALCULATIONS - attach additional sheet(s) as needed.

SECTION 01 57 15 – EXHIBIT C
NOISE MEASUREMENTS REPORT FORM

Contract No(s):

Date:

Time:

Measured By: _____ Of: _____ (Company)

Monitoring Address: _____ (Provide Sketch on Back)

Location No: _____ Wind Speed: _____ Km/Hr Direction: _____
(MPH x 1.6)

Location of Sound Level Meter: (No closer than 15 meters from equipment and 3 meters from building)

Monitoring was Conducted: _____ Meters from Equipment (_____)
(Type(s): Leave Blank for Baseline)

Land Use: ☐ Residential/Institutional ☐ Business/Recreational ☐ Industrial

Sound Level Meter: Make and Model: _____ ☐ A - Weighted Sound Level (Slow)

Duration of Measurement: _____ (20 minutes to 1 hour)

Calibration Level	
Leq	
L25	
L08	
L02	
Lmax	
Allowable Noise Limit	

Field Notes;

Check one of the following:

☐ Ongoing Construction ☐ Post-Construction: _____ ☐ Baseline Conditions
(Contract)

(Complete all that apply below)

Active Contract(s): _____
(List all contracts that contribute to measured noise)

Complaint Response: _____
(Describe: Include Log-In Number)

Abatement Follow-Up: _____
(Describe)

END OF EXHIBIT

SECTION 01 57 15 – APPENDIX A
OTHER NOISE SENSITIVE LOCATIONS

In addition to residential areas, hospitals and parks, the following locations are considered
Noise Sensitive Locations

Description	Address or Location

END OF APPENDICES

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes specifications for:
 - 1. Existing and new product requirements
 - 2. Procedures for selecting products
 - 3. Sound Transit furnished materials
 - 4. Manufacturers' instructions
 - 5. Nameplates
 - 6. Delivery, storage and handling requirements

1.02 DEFINITIONS

- A. Reused Products or Materials: Products or materials recovered during demolition or construction for subsequent use in its same or similar form.
- B. Renewable Products or Materials: Products or materials made from plants harvested on a less than 10 year cycle.
- C. Recycled Products or Materials: Products or materials generated by households, commercial, industrial or institutional facilities which have served their intended use.
- D. Regional Products or Materials: Products or materials that have been extracted, harvested, recovered or manufactured within 500 miles of the project site.

PART 2 - PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Unanticipated historic items encountered during the Work will remain the property of Sound Transit. Notify Sound Transit promptly upon discovery. Protect, remove, handle and store as directed by Sound Transit.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to Sound Transit or otherwise indicated to remain the property of Sound Transit, become the property of the Contractor. The Contractor is responsible to remove them from site and dispose of lawfully.

2.02 NEW PRODUCTS

- A. Do not use products having the following characteristics:

1. Made using or containing CFCs or HCFCs
 2. Made of wood from newly cut old growth timber
- B. Where all other criteria are met, give preference to products that:
1. Are extracted, harvested and/or manufactured closer to the location of the project
 2. Have longer documented life span under normal use
 3. Result in less construction waste

2.03 PROCEDURES FOR SELECTING PRODUCTS

- A. General: The specified requirements for individual products indicated in the Contract are multiple in nature and may include generic, descriptive, proprietary, performance, prescriptive, proscriptive, compliance with standards, compliance with codes, conformance with graphic details and other similar forms of requirements.
1. Noncompliance of a named product: If it is known that a named product or product source does not comply with requirements or is no longer available, advise the Resident Engineer before proceeding.
 2. Equivalent materials and equipment: Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, the specific item mentioned is understood as establishing type, function, dimension, appearance and quality desired. Another manufacturer's product may be acceptable provided the specification does not require a designated matching product or is a "no substitution" product, and provided that sufficient information is submitted as required by Contract in order to allow the Sound Transit to determine that the products proposed are equal to or better than those named.
 3. Sustainable requirements: Select products with a goal of incorporating 25% (by cost) of materials made from reused, renewable, recycled and/or regional materials within the project.
- B. Procedures: The options for selecting products are limited by the specified requirements and governing regulations. The following are some of the various selection procedures for specified requirements:
1. Characteristics or Performance Requirements: Provide products that comply with the specific qualities indicated and which are recommended or certified in writing by manufacturer for the specific use indicated. General performance of a product is implied where product is specified for specific performances.
 2. Prescriptive Requirements: Provide products produced in accordance with the prescriptive requirements, using the specified ingredients and components, and complying with the specified requirements for mixing, fabricating, curing, finishing, testing and similar operations.
 3. Or Approved Equal: Where named products or sources are accompanied by the term "or approved equal" or other language of similar effect, provide one of the specified products or submit a request for substitution for a product not named, which the Contractor judges to be of equal or better quality.
 4. Product names: Unless otherwise indicated, products identified by name mean a manufacturer's product as recorded in published literature, of latest issue

preceding the date of Contract Documents. Submit request for substitution in order to use products of a later or earlier model.

5. **Basis-of-Design Product:** A single product identified by name, which cannot be generically represented in the Contract. This product will be identified and detailed in the Contract Documents to indicate sizes, profiles, dimensions and other characteristics based on that product. If another manufacturer's product is proposed by the Contractor, the Contractor is responsible for necessary modifications to the structure and adjacent work and assuring coordination of any substituted product/system. The Contractor assumes all risk of necessary re-design and / or re-construction.
 6. **Comparable Product:** A product deemed acceptable if demonstrated and approved through the 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 the specified product. Other products that meet the specified requirements and are sufficiently equivalent to the Basis-of-Design product in quality (design, configuration, color, pattern, texture, sheen, etc.) to satisfy the design intent of the Designer of Record, may be submitted for consideration. Sound Transit will be the sole judge of aesthetic equivalence.
 7. **Visual Matching:** Where matching an established sample is required, Sound Transit will make final judgment of whether a product proposed by Contractor matches the sample satisfactorily.
 8. **Visual Selection:** Where product requirements include "... as selected from manufacturer's standard colors, patterns, textures..." or words of similar effect, the selection of manufacturing source and basic product, which complies with the requirements, is the Contractor's option, but the selection of color, pattern and texture is Sound Transit's responsibility.
- C. **NonConforming Products:** Use of a product not conforming to specified requirements may only be approved by means of a request for substitution as specified elsewhere.
- D. **Precedence of Specification by Characteristics, Reference Standard and Source:** If it occurs that a product cannot be supplied to meet all requirements, the following order of precedence will be followed:
1. **Characteristics:** For product specified by characteristics or description, and also by reference standard or by source and name, the specified characteristics or description shall take precedence.
 2. **Reference standards:** For product specified by reference to a published standard and by source or name, the reference standard shall take precedence over the source.

2.04 MANUFACTURERS' INSTRUCTIONS

- A. Maintain one (1) set at the site until installation is complete.
- B. Should job conditions or specified requirements conflict with the manufacturers' instructions, notify the Resident Engineer.

2.05 NAMEPLATES

- A. Except as otherwise indicated for required labels and operating data, attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of the products either in occupied spaces or on the exterior of the work.

- B. Labels:
 - 1. Locate required product labels and stamps on a concealed surface.
 - 2. Attach labels where required for observation after installation, on inconspicuous accessible surfaces in occupied spaces.
- C. Equipment Nameplates:
 - 1. Provide a permanent nameplate on each item of service-connected or power-operated equipment. Indicate the manufacturer, product name, model number, serial number, capacity, speed, ratings and similar essential operating data. Equipment nameplates shall be stainless steel.
 - 2. Locate nameplate on an accessible surface, which, in occupied spaces, is not conspicuous.

PART 3 - EXECUTION

3.01 TRANSPORTATION

- A. Transport products in accordance with manufacturer's instructions.
- B. Pack and brace items while transporting to the site from the plant of manufacture in order to prevent damage. Protect all items from conditions that might have a detrimental effect.

3.02 DELIVERY

- A. Deliver materials in original, sealed containers or packages in an undamaged condition complete with labels and instructions for handling, storing, unpacking, protecting and installing.
 - 1. Promptly inspect shipments to ensure that products comply with requirements, the quantities are correct and the products are undamaged.
 - 2. Do not remove from containers or destroy labels until ready for installation unless otherwise approved by the Resident Engineer.
 - 3. Arrange for the return of packing materials, such as wood pallets, where economically feasible.
- B. Designate receiving/storage areas for incoming materials so that they are delivered according to installation schedule. Minimize long-term storage at Project site and overcrowding of construction spaces.
 - 1. Place materials convenient to work area in order to minimize waste due to excessive handling and misapplication.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, sensitive to deterioration, subject to theft or other losses.
- C. Verify that equipment supplied and installed under other contracts, but required for the work in this Contract, is compatible.

3.03 STORAGE

- A. All equipment and materials shall be stored in accordance with the manufacturer's recommendations or as specified in the Contract Documents in order to preserve their quality and fitness for the Work. Provide weatherproof, secure storage for materials and equipment at Project site.
 - 1. Stored equipment and materials, although determined acceptable for the Work upon delivery or during storage, must again be inspected by the Contractor for acceptability before their incorporation into the Work.
 - 2. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- B. Coordinate location with Resident Engineer. Organize and arrange storage to allow accessibility for inspection, measurement of quantity, and for efficient and timely installation.
 - 1. Comply with product manufacturer's written instructions for temperature, humidity, ventilation and weather-protection requirements for storage.
 - 2. Store products, that are subject to damage by the elements, , above ground, in a weathertight enclosure with ventilation adequate to prevent condensation.
 - 3. Protect stored material from damage and from sunlight. Do not mark in a manner that will remain visible after installation or which will affect performance or appearance.
 - 4. Protect stored products from damage and liquids from freezing.
 - 5. For exterior storage of fabricated products, place on level supports above ground.
 - 6. Store loose, granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- C. Store materials in a manner that will not endanger the Project structure.
- D. Sound Transit-furnished materials or materials paid for before incorporation shall be stored in secure locations approved in writing by Sound Transit in a manner that will preserve their full value. Such materials shall be prominently labeled as property of Sound Transit and shall not be commingled with non-Sound Transit owned materials. If necessary, storage shall be in controlled environment buildings.
- E. Off-Site Storage:
 - 1. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
 - 2. Label with project name, project address and Contractor's name. Insure for full replacement value.
 - 3. If requested by the Contractor and approved in writing by Sound Transit, Sound Transit may make payment to the Contractor for products stored off-site prior to their installation. Such payment will be approved by Sound Transit, only when Contractor has furnished evidence, satisfactory to Sound Transit, of compliance with the requirements of the Contract and, in addition, documentation outlining type and location of storage facilities and a method of inventory, suitable to account for all such materials and products, until installed in the Work.

3.04 HANDLING

- A. Handle products in accordance with manufacturer's instructions when off-loading equipment and materials at jobsite.
- B. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement or damage.

END OF SECTION

SECTION 01 71 23
FIELD ENGINEERING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for construction surveying of the Work and if required, for field measurement of Work quantities.

1.02 SUBMITTALS / TRANSMITTALS

- A. Submittals
 - 1. Qualifications of Surveyor-in-Charge
- B. Transmittals
 - 1. Instrument calibration reports, upon request
 - 2. Cut sheets for all open cut pipeline and pavement restoration work.
 - 3. Survey field notes, survey calculations and electronic files
 - 4. Approved permit and completion report

1.03 QUALITY ASSURANCE

- A. Perform all survey work under the direction and supervision of a Licensed Professional Land Surveyor registered in the State of Washington.
- B. The surveyor-in-charge of the field work shall have a minimum of 5 years of experience as surveyor-in-charge on Work of comparable scope, magnitude and complexity.
- C. Perform all survey work in conformance with the Contract and survey requirements imposed by State of Washington and / or the local jurisdiction(s) through a permit, development condition, law or regulation.

1.04 PROJECT CONDITIONS

- A. Construction Control monuments and benchmarks, generally referred to as Construction Control Points (CCPs), will be provided by Sound Transit. CCPs for vertical and horizontal control are indicated on the Contract Drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONSTRUCTION

- A. General:

1. Prior to the start of Work, verify the coordinates and elevations of the CCPs as shown on the Contract Drawings. Inform the Resident Engineer of any discrepancies which may be identified. The Resident Engineer will work with the designer and the Contractor to resolve such discrepancies.
2. Maintain all CCPs and replace those that become damaged or destroyed, at no additional cost to Sound Transit.
3. Use provided CCPs to control establishment of the lines and grades required for completion of the Work.
4. From the CCPs establish and maintain all secondary or additional survey control and control points, stakes, hubs or marks as needed for the construction of the Work. As necessary re-establish such secondary or additional survey control and control points, stakes, hubs or marks that become damaged or destroyed, at no additional cost to Sound Transit
5. Develop and maintain detailed survey records that allow the survey work to be retraced.
6. Maintain and preserve all monuments, stakes and markers outside the construction limits. In the event that monuments, stakes or markers are destroyed or damaged, replace them at no cost to Sound Transit. Provide new replacement monuments and boxes when removed or damaged during construction.
7. Identify survey control monuments within the construction limits that have the potential to be disturbed or removed during construction. Prepare and file a Washington State Department of Natural Resources (DNR) Permit to Destroy or Remove Survey Monument for each monument that falls into this category. Prepare and file the Completion Report for Monument Removal or Destruction with the DNR once the monuments have been replaced.
8. Perform all surveys for layout and performance of the Work, reduce the field notes and make all necessary calculations and drawings to carry out such work. Check the relative positions of all monuments and benchmarks each time monuments or benchmarks are used.
9. Use instruments and other survey equipment that are accurate, suitable for the surveys required in accordance with recognized professional standards and in proper condition and adjustment at all times. Carry out instrument calibrations prior to the start of survey work and every 12 months thereafter. Furnish calibration reports upon request.
10. Record all surveys manually in field notebooks or automatically by electronic means. Furnish a certified copy of the original pages of field books or printed copies of the electronic records to the Resident Engineer upon request. Furnish each field notebook and an electronic copy of the electronically recorded data to the Resident Engineer at the completion of the project or sooner if requested.
11. The Resident Engineer may check the Contractor's surveys at any time as those surveys are a part of the Work required by the Contract. The Contractor is responsible for lines, grades or measurements, which do not comply with specified or proper tolerances or which are otherwise defective, and for the resultant defects in the Work. Conduct resurveys or check surveys to correct errors indicated by review of the field notebooks or electronic data.

12. The Resident Engineer may require that work be suspended at any time when the location and limit marks established by the Contractor are not reasonably adequate to permit inspection of the Work.
13. In advance of any restoration paving, produce survey information to check the line and grade used for paving elevations and slopes.

B. Surveys for Underground Structures

1. Establish and maintain control for line and grade within the underground construction.
2. Complete an optical survey and immediately provide survey results for the actual tunnel alignment, grade and temporary and permanent lining configuration on, at least, a weekly basis or at 300-foot intervals for the tunneling progress, whichever comes first, or sooner if required by the Resident Engineer. Immediately verify apparent changes in location or deviations from allowable tolerances and notify the Resident Engineer.
3. Adjust the published coordinates (horizontal and vertical) of these survey points as necessary and provide the revised coordinates to the Resident Engineer as soon as possible after verification of the location information.
4. Follow up the surveys with an As-Built Drawing, indicating the results of the survey and any deviation from the tolerances as indicated in the Contract Documents.

C. Surveys for Measurement and Payment

1. Perform surveys for all unit priced Contract Price Schedule items that are necessary to be measured by surveying methods.
2. Reduce the field notes and calculate quantities for payment purposes. Provide a duplicate copy of the note reductions and calculations to the Resident Engineer.

D. Surveys for Record Drawings (As-Built Drawings)

1. Perform surveys as required to accurately indicate the record (as-built) information for all components of the Work.

E. Surveying Accuracy and Tolerances in Setting Survey Stakes or Markers

1. Perform all control traverse field surveys and computations, including surveys of main control lines to determine alignment of major structure components, to a precision of at least 1:20,000 after azimuth closure and adjustment.
2. Set survey stakes or markers within the tolerances in Table A, herein, unless more stringent tolerances are specified elsewhere in the Contract Documents. Table A does not otherwise relieve the Contractor of responsibility for measurements in compliance with the Contract requirements.
3. Do not exceed the following tolerances in setting survey stakes or markers:

TABLE A - SURVEYING ACCURACY AND TOLERANCES

	Tolerance in Staked Point	
Setting Survey Stakes or Markers:	Horizontal	Vertical
Markers on hubs and monuments on centerlines and offset centerlines.	0.02 foot	0.01 foot
Intermediate Stakes or Markers on Centerlines and Offset Centerlines for:	Horizontal	Vertical
Rough excavation and embankment for roads and for other work not otherwise provided	0.12 foot	0.10 foot
Trimming of excavation and embankment, unless otherwise provided	0.12 foot	0.10 foot
Structures (including at-grade, aerial and underground), building construction,	0.02 foot	0.01 foot
Equipment installation	As required by manufacturer	
Trimming or preparation of earth subgrade for roadways, trackway, concrete pipe and other concrete structures	0.12 foot	0.10 foot
Trackway sub-ballast, roadway sub-base and base, steel pipe and for other work not otherwise provided	0.12 foot	0.05 foot
Roadway surfacing, steel reinforcement, concrete pipe and other formed concrete	0.05 foot	0.02 foot

END OF SECTION

SECTION 01 71 30

PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

PART 1 - GENERAL

1.01 SUMMARY

This Section specifies protection and maintenance of underground and aboveground utilities, structures, fences, parking strips, sidewalks, driveways, streets and other improvements, which may be affected by the Work.

1.02 DEFINITIONS

A. Conflict: An existing Major Underground Utility is considered to be in Conflict if:

1. It crosses or projects into the specified excavation at an elevation between the top and bottom of the proposed Facility
2. When parallel to a proposed Facility within the zone-of-influence (1:1)

If the proposed Facility does not meet the above listed requirements, then no Conflict exists.

B. Facility: A real property entity consisting of one or more of the following: an underground or aboveground utility system or structure, pavement or other improvement.

C. Major Utility: A transmission, collection or distribution line that is not considered a Minor Utility.

D. Minor Utility: Any Service Line regardless of size or type, water lines of 4-inch diameter and less, sanitary sewer lines of 6-inch diameter and less, natural gas lines of 2-inch diameter and less, and any irrigation line, including all appurtenances.

E. Service Line:

1. Utility line, the function of which is to directly connect the improvements on an individual property (e.g., residential, industrial or commercial) to a larger utility system line, located off said property or in an easement / right of way on said property, to which other utility lines also connect.
2. Any cable or conduit that supplies an active feed from a utility Owner's facilities to activate or energize any federal, state or local governmental entity's local lighting and electrical systems, traffic control systems, street lights, communication systems or irrigation systems.

Service lines which are encountered and which may need relocation or other changes to achieve the Work shall not be considered as the basis of any Claim or Change Order, or for payment under the Provisional Sum Item for Unidentified Utility Conflicts

1.03 SUBMITTALS / TRANSMITTALS

A. Listing and schedule of all potholing

B. Listing of utilities/facilities to be physically protected and relocated

- C. Listing of utilities/facilities to be physically protected and supported in place
- D. Qualifications for independent third party pre- and post-construction inspectors
- E. Pre- and post-construction inspections and surveys of utilities and buildings
- F. WSDOT Pavement Survey Work Plan

1.04 QUALITY ASSURANCE

Independent, third-party inspectors shall have a minimum of 5 years performing work of similar nature.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 LOCATION OF EXISTING FACILITIES

- A. Coordinate efforts to locate existing underground utilities. A minimum of 30 days prior to work in the location of a utility, review with the Resident Engineer the locations of existing utilities in relation to the Work and evaluate areas of conflict and potential conflict.
- B. Excavate (pothole) and expose existing Major and Minor Underground Utilities prior to the work to determine utility dimensions and elevations.
- C. Sound Transit will not be liable for utility protection, modification and relocation that is not indicated on the Contract Drawings but is required by the Contractor due to its means and methods. Determine the requirements of the Work specified in the Contract Documents and make necessary provisions for the protection, modification, support and/or relocation of utilities or other facilities as necessary to perform the Work.
- D. Remove, plug or fill abandoned pipelines in accordance with the local jurisdiction's requirements.
- E. Storm and sanitary sewers:
 - 1. Existing live sewers shall remain in service, unless otherwise indicated.
 - 2. If interruption of sewers is required, provision shall be made for disposal of existing flows.
 - 3. Immediately repair, to a condition equal to or better than that existing prior to the damage, construction damage caused to the existing sewer system and manholes.
 - 4. With prior approval from the local authority having jurisdiction, flush existing pipes that were affected by the Work, from the point of the next upstream connection. Clean and repair all pipelines or manholes affected by gravel, rocks or other debris that has entered the existing system during construction.
 - 5. Connection of new Work to an existing manhole or sewer line shall not be made until approved by the Resident Engineer.
- F. Aboveground electrical cable and communication facilities:
 - 1. Support poles that are at risk of being undermined by the Work.

2. Comply with all applicable requirements and regulations for work in the vicinity of energized primary conductors.
- G. Underground electrical cable, communication and fiber optic facilities:
1. Protect these underground facilities and accomplish with the Work of the Contract.
 2. Fiber optics:
 - a. When not indicated on the Contract Drawings and if in conflict with the new facility, meet and agree with the Resident Engineer and the utility owner on how to proceed.
 - b. When not indicated on the Contract Drawings and not in conflict with the new facility, no additional payment will be considered.
- H. Gas:
1. As required by the appropriate utility owner, protect, maintain, support in place or relocate all gas mains crossing pipeline trenches and other elements of the Work.
 2. Provide a minimum of 12 inches of clearance, measured from edge to edge, between gas mains or gas service lines and new facilities.
 3. If relocating either utility to obtain the 12 inches of clearance is not practical, provide a protective wrap for the entire distance where there is less than 12 inches of clearance.
 4. Provide a split polyvinyl chloride (PVC) pipe or PVC wrapping of at least 0.04 inch in thickness, applied to gas mains and lines.
 5. Protect and maintain all temporary gas service slack lines during pipeline installation.
 6. Notify the gas utility owner through the Resident Engineer at least 30 days in advance of excavation in the vicinity of high-pressure gas mains.
- I. Water:
1. Maintain water service along the alignment of Work at all times, unless otherwise permitted by the Resident Engineer for utility service cutovers.
 2. Existing thrust blocks are not indicated on the Contract Drawings. Assume that thrust blocks are present at all water line deflections of 11.25 degrees or greater.
- J. Roadways:
1. Take adequate precautions to protect existing sidewalks, driveways, parking strips, curbs, pavements, fences, utilities, adjoining property structures and other improvements to avoid damage thereto.
 2. Protect and replace traffic signage, paint striping and channelization, if damaged by the Contractor's operation.
 3. Unless otherwise indicated, maintain the existing illumination pattern for signs and roads at all times.

4. Install temporary roadway lighting, as necessary.

3.02 SHORING AND BRACING

Shore up, brace, underpin and protect, as necessary, the foundations and other parts of existing structures adjoining the Site of the Work that may be affected by the Work.

3.03 PRE- AND POST-CONSTRUCTION VIDEO INSPECTION UTILITY SURVEYS

For those utilities listed in Appendix A to this Specification Section, have an independent third party perform closed circuit television (CCTV) inspection surveys at least 30 days prior to the start of construction in the vicinity of the utility lines to be surveyed. Have the inspecting party perform a post-construction CCTV inspection surveys within 60 days following the completion of construction in the vicinity of the utility lines to be surveyed. Transmit a copy of the pre- and post- construction CCTV inspection survey records to Sound Transit with 30 days after performing each inspection survey. The inspecting party shall maintain the original CCTV inspection survey records until Acceptance of the Work. Transmit the original pre- and post-construction CCTV inspection survey records to Sound Transit within 60 days after Acceptance of the Work, or within a time period specifically authorized by the Resident Engineer. Notify local utility owners of the planned inspections a minimum of 7 days in advance. Coordinate inspections with the local utility owners.

3.04 PRE- AND POST-CONSTRUCTION LEAK DETECTION UTILITY SURVEYS

For those utilities listed in Appendix A to this Specification Section have an independent third party perform pre-construction leak detection surveys at least 30 days prior to the start of construction in the vicinity of the utility. Have the independent third party perform a post- construction leak detection survey within 60 days following the completion of construction in the vicinity of the utility lines to be surveyed. Transmit a copy of the pre- and post-construction leak detection survey records to Sound Transit with 30 days after performing the leak detection survey. The inspecting party shall maintain the original leak detection survey records until Acceptance of the Work. Transmit the original pre- and post-construction leak detection survey records to Sound Transit within 60 days after Acceptance of the Work, or within a time period specifically authorized by the Resident Engineer. Notify local utility owners of the planned inspections a minimum of 7 days in advance. Coordinate inspections with the local utility owners.

3.05 PRE- AND POST-CONSTRUCTION BUILDING, BRIDGE, UTILITY TUNNEL, PARKING GARAGE, SURFACE FEATURE SURVEYS

- A. Have an independent third party conduct pre- and post-construction inspections of the facilities listed in Appendix A to this Specification Section.
- B. Pre-construction surveys shall document interior and exterior inspections of conditions prior to commencement of construction activities in the vicinity of the facilities to be surveyed. Post-construction surveys shall document interior and exterior inspections of conditions subsequent to Acceptance of the Work.
 1. Survey documents including but not limited to the following:
 - a. Handwritten notes
 - b. Audio notes on tape
 - c. Color photographs and videos:
 - 1) Requirements for photographs and videos are specified elsewhere in the Contract

- 2) Include time stamp and narrative giving location of the items being shown.
 - 3) Identify houses and buildings visually by house number, when visible.
 - d. Inspection forms approved by the Resident Engineer
 - e. Document all visible cracks, defects or unusual conditions. Document and record all comments made by property owners during inspections.
2. Coordinate all pre- and post-construction surveys with the Resident Engineer. Do not perform pre- or post-construction surveys unless accompanied by the Resident Engineer or its designee.
 3. Transmit a copy of each inspection to Sound Transit within 30 days after completion of that survey. Have the independent third party perform a post-construction inspection within 60 days following the completion of construction in the vicinity of the facility to be inspected. Have the independent third party maintain the original inspection reports until Acceptance. Transmit the original pre- and post-construction inspection reports to Sound Transit within 60 days after Acceptance of the Work or within a time period specifically authorized by the Resident Engineer.
 4. Do not access private property unless a right-of-entry permit has been obtained through Sound Transit or a temporary construction easement is granted to the Contractor through the terms of the Contract. Maintain a log of the rights of entry and permitted access for each property and the dates of entry on which the surveys of the current conditions were performed.
- C. For those WSDOT facilities listed in Appendix A to this Specification Section, have an independent third party perform pre- and post-construction survey inspections.
1. Perform all pre-construction surveys of WSDOT bridges, overpasses, retaining walls and pavements prior to commencement of the Work on or in the vicinity of the structures.
 2. Perform all post-construction surveys of WSDOT bridges, overpasses, retaining walls and pavements within 60 days after the Work is complete
 3. WSDOT Pavement Survey Work Plan:
 - a. Describe in detail proposed methods and equipment to be used to survey WSDOT pavement elevations and grades to an accuracy of 0.01 foot.
 - b. Photograph pavement surfaces.
- D. For those haul routes listed in Appendix A to this Specification Section, videotape the haul routes before the start of construction and then once every year thereafter until Acceptance of the Work. Requirements for video recording are specified elsewhere in the Contract.

END OF SECTION

APPENDIX

Appendix A: Protection and Maintenance of Property and Work

SECTION 01 73 29
CUTTING, FITTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

This Section includes requirements for cutting, fitting and patching required to accomplish the Work. This Section is to be used in conjunction with other specification sections which may stipulate additional requirements or place limitations on the cutting, fitting and patching activities.

1.02 SUBMITTALS

- A. Written Request for Approval: For all cutting, fitting or patching which affect the following:
 - 1. Work by Sound Transit or another contractor
 - 2. Structural value or integrity of any element of the Project
 - 3. Integrity or effectiveness of weather exposed or moisture resistant elements or systems
 - 4. Building aesthetic qualities for exterior areas or in occupied spaces
 - 5. Efficiency, operational life, maintenance or safety of operational systems,

- B. Cutting, Fitting, and Patching Proposal: The Contractor is to submit a written request to and receive approval from the Resident Engineer prior to proceeding with the cutting, fitting or patching Work. The written request shall include the following:
 - 1. A description of the extent of cutting, fitting and patching required, including a description of how it will be performed and why it is required, if it cannot be avoided.
 - 2. A description of anticipated results in terms of changes to existing construction, including changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 - 3. A list of utilities that will be disturbed or affected, including those that will be relocated and those that will be temporally out of service, including how long service will be disrupted.

- C. Structural Details and Engineering Calculations: Where cutting, fitting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure to satisfy requirements.

- D. Proposed Change of Materials or Methods: Should conditions of work or schedule dictate a change of materials or methods, submit written recommendations to Resident Engineer, including:
 - 1. Conditions necessitating the change

2. Recommendations for alternative materials or methods
3. Submittal as required for substitution

1.03 QUALITY ASSURANCE

- A. Do not cut and patch structural elements in a manner that would change their load carrying capacity or load deflection ratio.
- B. Do not cut and patch operating elements or related components in a manner that would result in:
 1. Reducing their capacity to perform as intended.
 2. Increased maintenance or decreased operational life or safety.
- C. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Sound Transit's opinion, reduce the building's aesthetic qualities.
- D. Do not cut and patch construction in a manner that would result in visual evidence of cutting, fitting and patching.
 1. If possible retain the original installer or fabricator to cut and patch exposed Work. If it is impossible to engage the original installer or fabricator, engage another recognized experienced and specialized firm.
 2. Remove and replace construction that has been performed in a visually unsatisfactory manner, as determined by Sound Transit.

PART 2 - PRODUCTS

2.01 MATERIALS

Use materials that are:

- A. Identical to the existing materials, whenever possible, or
- B. For exposed surfaces, visually match the existing adjacent surfaces to the fullest extent possible, if identical materials are unavailable or cannot be used, and
- C. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Before commencing the cutting, fitting or patching, examine surfaces to be cut and patched, and the conditions under which the Work is to be performed. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.
- B. After uncovering Work, inspect conditions affecting installation of new products.
- C. Report unsatisfactory or questionable conditions to the Resident Engineer in writing and do not proceed with the Work until the Resident Engineer has provided further instruction.

3.02 PREPARATION PRIOR TO CUTTING AND FITTING

- A. Provide shoring, bracing and support as required to maintain structural integrity of the affected portion of the Work.
- B. Protect existing Work, furnishings and equipment during cutting, fitting and patching to prevent damage.
- C. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting, fitting and patching operations.
- D. Avoid interference with the use of adjoining areas or interruption of free passage to adjoining areas.

3.03 PERFORMANCE

- A. Employ skilled workmen to perform cutting, fitting and patching.
- B. Proceed with cutting, fitting and patching at the earliest feasible time and complete without delay.
- C. Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible, review proposed procedures with the original installer. Comply with the original installer's recommendations.
 - 1. In general, where cutting and fitting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping.
 - 2. Cut holes and slots neatly to the size required with minimum disturbance of adjacent surfaces.
 - 3. Temporarily cover openings when not in use.
 - 4. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 - 5. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
 - 6. Where utility services, such as pipe or conduit, are shown or required to be removed, relocated or abandoned, bypass the utility services before cutting. Cut pipe or conduit in walls or partitions to be removed. Install cap or valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after bypassing and cutting.
- D. Patch so that the seams are durable and as invisible as possible. Comply with specified tolerances.
 - 1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 - 2. Restore the exposed finishes of patched areas and extend the finish restoration into the undisturbed adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 3. Where removal of walls or partitions extends from one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. If necessary, remove the remaining existing floor and wall coverings from areas outside of the patch and replace with new materials to achieve uniform color and appearance.

4. Where patching occurs in a smooth painted surface, extend final paint coat over entire undisturbed adjoining area containing the patch, after the patched area has received primer and second coat.
 5. Patch, repair or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.
- E. Approval by the Resident Engineer to proceed with cutting, fitting and patching work does not waive the Resident Engineer's right to later require complete removal and replacement of Work found to be unsatisfactory.

3.04 CLEANING

Thoroughly clean areas and spaces where cutting and patching has been performed or which has been used as access. Completely remove paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishes are applied. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. In all cases, follow the specific permits for this project. If permits do not address the following provisions, these provisions apply:
- B. Section includes requirements for the following:
 - 1. Cleanup activities
 - 2. Salvaging nonhazardous construction and demolition (C&D) debris as required
 - 3. Recycling nonhazardous construction and demolition debris
 - 4. Disposing of nonhazardous construction and demolition debris
 - 5. Special project procedures for transients – homeless and illegal encampments

1.02 DEFINITIONS

- A. Bio-sweep: A process of inspecting the Site to identify and remove transients, removal, storage, and return of personal property, Site cleanup, which addresses all biological and associated physical hazards present, evictions, and periodic Site maintenance.
- B. Commingled C&D Recycling: A method of recovery where recyclable construction and demolition debris are mixed together at the Work Site and brought to a recycling facility for sorting.
- C. Construction and Demolition Debris: Construction, Demolition and Land Clearing Debris (CDL). All non-hazardous solid waste and building materials resulting from construction, remodeling, renovation, repair, demolition, selective demolition, and land-clearing operations. Consists of, but is not limited to, wood waste, concrete, brick, asphalt, other aggregates, gypsum wallboard, glass, scrap metal, roofing, siding, wire, insulation, packaging materials, intact building materials and fixtures, and land-clearing debris such as, brush, shrubs, plants, limbs and trees.
- D. Deconstruction: The systematic disassembly of a structure in order to maximize the salvage of reusable building materials first and to recycle materials second.
- E. Disposal: Off-site removal of construction and demolition debris and subsequent final deposit in landfill or incinerator.
- F. Recycling: Recovery of Construction and Demolition Debris for subsequent processing (sorting, cleaning, treating, reconstituting) in preparation for use in the manufacture of a new product.
- G. Reuse: Recovery of Construction and Demolition Debris and subsequent use of the material in its same or similar form. Materials can be reused on Site or in other Work. Examples include, but are not limited to, grinding concrete for use as subbase material; chipping land-clearing debris for use as mulch.

- H. Salvage: Recovery of Construction and Demolition Debris for subsequent sale. Reuse in another facility, or donation to a third party.
- I. Source-Separated C&D Recycling: The process of separating recyclable Construction and Demolition Debris in separate containers as they are generated at the Work Site. The separated materials are hauled directly to a Recycling facility.

1.03 SUBMITTALS

- A. Site-specific Waste Management Plan
- B. Waste Management Progress Reports: Concurrent with each Application for Payment and no less frequently than monthly, submit report (Exhibit A for construction Work and for demolition Work). Include the following information and any additional requirements (not listed below):
 - 1. Generation point of waste (including project address)
 - 2. Total quantity of waste generated in tons
 - 3. Quantity and type of waste reused
 - 4. Quantity and type of waste salvaged
 - 5. Quantity and type of waste recycled
 - a. Specify collection method (source-separated or commingled). For commingled materials, include verification of the recycling rate for commingled loads at the facility (or provide King County certified facility diversion rates).
 - 6. Total quantity and types of waste recovered (reused plus salvaged plus recycled) in tons
 - 7. Total quantity of waste recovered (reused plus salvaged plus recycled) as a percentage of total waste generated
 - 8. Statement of discovery of Hazardous or Contaminated Substances. Report abatement, remediation, disposal methods and provide final report from certified hazardous material vendor
 - 9. Statement of current regulatory compliance for all facilities receiving waste
 - 10. If directed by Sound Transit, the Contractor shall use King County waste reporting requirements in lieu of the form in Exhibit A.
 - 11. Final Progress Report, summarizing all efforts and totaling waste recovered, to be submitted upon Substantial Completion.
- C. Qualification Data: For waste management coordinator and recycling facility (certification)
- D. Waste Management Calculations: Prior to Substantial Completion, submit calculated end-of-Contract rates for Reuse, Salvage, Recycling, and Disposal as a percentage of total waste generated by the Work.
- E. Records of Donations: Indicate receipt and acceptance of reusable or salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- F. Records of Sales: Indicate receipt and acceptance of reusable or salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

- G. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities permitted or certified to accept them. Include manifests, weight tickets, receipts, and invoices.
- H. Landfill, Incinerator, and Intermodal Facility Disposal Records: Indicate receipt and acceptance of waste by landfills, incinerator, and intermodal facilities permitted to accept them. Include facility diversion reports, manifests, weight tickets, receipts, and invoices.
- I. Prepare a written plan for Work Site cleanup or bio-sweep in accordance with requirements specified in Article 1.06 herein. The plan can be incorporated into or follow the requirements of the Hazardous or Contaminated Substance Health and Safety Plan Hazardous or Contaminated Substance Health and Safety Program. Submit the plan to the Resident Engineer prior to commencing cleanup Work.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Construction and demolition waste management activities in compliance with all applicable regulations of authorities having jurisdiction for the Work.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of Waste Management Work Plan.
- C. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program if applicable.
- D. Waste Management Pre-Construction Meeting: Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each material type and their disposition.
 - 3. Review and finalize procedures for materials separation and verify adequate availability of containers and bins.
 - 4. Review procedures for periodic material collection and transportation to Recycling and Disposal facilities.
- E. Training: Provide mandatory on-site instruction on appropriate separating, handling, recycling, recovering, and compost methods to be used by all parties at the appropriate stages of the Work at the Site. Distribute waste management plan to entities when they first begin work on Site and review at regular job and safety meetings.
- F. Signage: Provide consistent recycling and composting signage throughout the jobsite offices and jobsite at points of creation/collection (lunchrooms, kitchens). Graphics shall be consistent in color, image, and message, while be located on every collection container and areas where waste is generated.
- G. Include discussion of waste management and Recycling in regular quarterly job meeting and job safety meetings conducted during the course of work at the Site. Include report out of landfill diversion rates, items recently salvaged or reused, and discuss improvement opportunities (recyclables spoiled through mis-sorting).

1.05 WASTE MANAGEMENT PLAN

- A. Develop a waste management plan consisting of methods for waste identification. Include separate sections in Plan for Demolition and construction waste. Indicate types and quantities by weight.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, land clearing and construction waste generated by the Work, as listed in Exhibit A. Include estimated quantities and assumptions for estimates.
- C. Confirm through an Asbestos Hazard Emergency Response Act (AHERA) Inspection Report and other investigation reports for Hazardous or Contaminated Substances that the Project Site does not contain Hazardous or Contaminated Substances. A report or the Hazardous Building Material Clearance form indicating the Project Site has been remediated or does not contain Hazardous or Contaminated Substances is required to be provided to the Waste Management Coordinator and distributed to all haulers and receiving Salvage and Recycling facilities, in accordance with regulations of authorities having jurisdiction, such as the Puget Sound Clean Air Agency and Washington Department of Labor and Industries.
- D. List each type of waste and whether it will be reused, 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 or other Work, 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. List individuals or organizations responsible for removing materials from Project Site (names, addresses, telephone numbers, and current insurance certificates).
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers. List individuals or organizations responsible for removing materials from Project Site (names, addresses, telephone numbers, and current insurance certificates).
 - 4. Recycled Materials: Include list of anticipated certified C&D receivers and processors and type of recycled materials each will accept. Include names, addresses, certification, and telephone numbers.
 - 5. Disposed Materials: Indicate how and where materials will be disposed. Include name, address, and telephone number of each facility, transfer station, landfill and incinerator facility.
 - 6. Handling and Transportation Procedures: Include methods that will be used for separating recyclable waste, including sizes of containers, container labeling, and designated location(s) where materials separation will be performed, and source-separated or commingled collection.
 - 7. Provide names, addresses, and telephone numbers of hauling contractor(s), as applicable.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

- F. Training: Indicate the procedures for mandatory on-site instruction on appropriate separation, handling, recycling, recovery, and compost methods to be used by all parties at the appropriate stages of the work at the Site. Distribute waste management plan to subcontractors when they first begin work on-site and review at regular job and safety meetings.
- G. Signage: Indicate the program for consistent signage at all collection containers and areas waste is generated.
- H. Reporting: Indicate reporting procedures for this project.

1.06 BIO-SWEEP HEALTH AND SAFETY PLAN

- A. Plan Requirements
 - 1. Prepare under the supervision of a certified industrial hygienist and incorporate all required County, State, and Federal health and safety provisions.
 - 2. Include requirements of the Federal Occupational Safety and Health Act of 1970 (OSHA), all amendments, and all other applicable health regulations.
 - 3. Include an initial Site assessment by the industrial hygienist prior to preparation of the plan.
 - 4. Break the initial cleanup into identifiable construction areas.
- B. At least one copy of the plan shall be posted at the Work Site while cleanup Work is in progress.
- C. The industrial hygienist shall perform one or more follow-up Site assessments as needed to approve the Site following completion of the initial Site cleanup.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Contract rates for Reuse/Salvage/Recycling of 80 percent minimum by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials during the Work. Use all reasonable means to divert deconstruction, construction and demolition debris from landfills and incinerators by one or a combination of the following activities in order of priority.
 - 1. Reuse
 - 2. Salvage
 - 3. Source-Separated C&D Recycling
 - 4. Commingled C&D Recycling
- B. Materials for which Reuse, Salvage, or Recycling is Required: In conformance with requirements promulgated by authorities having jurisdictions, and industry best practices, 100 percent of the following materials must be separated for Reuse, Salvage, or Recycling, regardless of Reuse/Salvage/Recycling goal indicated in Article 2.01A herein:
 - 1. Asphalt paving
 - 2. Asphalt roofing shingles

3. Brick
 4. Cardboard
 5. Carpet
 6. Concrete
 7. Gypsum Scrap (new construction only)
 8. Metals
 9. Plastic sheet and film
 10. Wood (readily recyclable – unpainted and untreated)
- C. Materials for which Reuse, Salvage, or Recycling are Practicable: material shall be Reused, Salvaged, or Recycled whenever practicable. Construction and Demolition Debris that can be Reused, Salvaged, or Recycled include, but are not limited to, the following:
1. Uncontaminated Packaging materials:
 - a. Paper
 - b. Polystyrene packaging
 - c. Wood crates
 2. Division 03 – Concrete
 - a. Concrete reinforcing steel
 - b. Concrete masonry units
 3. Division 06 - Wood, Plastics, and Composites
 - a. Vertical timbers
 - b. Glu-lam beams
 - c. Wood studs/joists
 - d. Plywood and oriented strand board (OSB)
 - e. Wood paneling
 - f. Wood trim
 - g. Wood decking
 - h. Casework
 4. Division 07 – Thermal and Moisture Protection
 - a. Insulation
 5. Division 08 - Openings
 - a. Doors and frames
 - b. Exterior wood windows

- c. Stained glass windows
 - d. Vinyl windows
 - e. Door hardware
 - f. Glazing
- 6. Division 09 – Finishes
 - a. Metal studs
 - b. Acoustical tile and panels
 - c. Carpet pad
- 7. Division 10 – Specialties
 - a. Demountable partitions
- 8. Division 11 - Equipment
 - a. Elevator equipment
- 9. Division 12 – Furnishings
 - a. Cabinets
- 10. Division 21 – Fire Suppression
 - a. Sprinklers
- 11. Division 22 – Plumbing
 - a. Plumbing fixtures
 - b. Piping – (see Division 5 Metals)
 - c. Supports and hangers - (see Division 5 Metals)
 - d. Valves
- 12. Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC)
 - a. Mechanical equipment – (see Division 5 Metals)
 - b. Refrigerants
- 13. Division 26 – Electrical
 - a. Electrical conduit
 - 1) Copper – (see Division 5 Metals)
 - b. Copper wiring – (see Division 5 Metals)
 - c. Lighting fixtures
 - d. Lamps
 - e. Ballasts
 - f. Electrical devices
 - g. Switchgear and panelboards

- h. Transformers
- i. Uninterrupted Power Source and Generators
- j. Conduit – (see Division 5 Metals)
- 14. Division 32 – Exterior Improvements
 - a. Landscape/hardscape materials – plants, pavers, rockeries, etc.

PART 3 - EXECUTION

3.01 GENERAL

- A. Take precautions and perform any necessary Work required to provide and maintain a safe and healthful jobsite for all workers and the public for the duration of the project in accordance with all applicable laws and contract requirements.
- B. Ensure that the public, including persons who may be non-English speaking or those who may not be able to recognize potential safety and health hazards within the project area, are not harmed by the Contractors activities.

3.02 CLEANUP DURING CONSTRUCTION

- A. Keep the entire Site in a neat and orderly condition at all times during construction.
 - 1. Conduct a general cleanup of the Site daily as a part of the Work.
 - 2. Provide general daily cleanup and disposal service for removal of waste and rubbish from the jobsite.
- B. Provide daily litter pickup and general cleanup within designated work limits. Clean up both construction and non-construction material, and perform bio-sweep. Provide trash receptacles for workers' lunches, cigarette butts, and other miscellaneous garbage.
 - 1. Dispose or recycle waste, compost, trash, and debris in a safe, acceptable manner in accordance with applicable laws and ordinances.
 - 2. Bury no waste material and debris on the Site.
 - 3. Burning of trash and debris on the Site is prohibited.
- C. Remove graffiti from walls, fences, trailers, and equipment within 24 hours.
- D. Remove materials and equipment from the Site when no longer necessary.
- E. Maintain planted landscape areas on the construction Site and as specified. Mow and weed areas as needed.

3.03 SPECIAL PROJECT PROCEDURES FOR TRANSIENTS – HOMELESS AND ILLEGAL ENCAMPMENTS

- A. The Work Site may include materials and waste that pose physical or biological safety and health hazards. These may include, but not be limited to, food, garbage, contaminated clothing and bedding, broken glass, human, bird, and animal excrement, drug paraphernalia including hypodermic needles, birds, bats, rodents, and other hazards. Personal property items, which are not considered a safety or a health hazard, shall not be disposed of without appropriate owner notification, as indicated in Article 3.03.C herein.

- B. The Work Site may be occupied by homeless and otherwise transient persons who may attempt to seek shelter in or near construction zones or services in the area during the day and at night. Transients may seek shelter in or under dumpsters, equipment, blankets, construction materials, or other spaces hidden from plain view. Transients may be under the influence of alcohol or drugs and it should not be assumed that loud construction noise would wake them. Prior to the removal of transient's personal property within the Project limits, the Contractor shall provide a minimum 72 hour public notification in accordance with Article 3.03.C. The Contractor's Health and Safety Plan shall include requirements for thorough daily Work area checks for unauthorized people prior to the start of Work.
- C. Public Notification
1. Furnish and install "No Trespassing" signage as part of initial Site posting and fencing activities.
 2. Provide written notification of the following to the Resident Engineer and to the chief law enforcement officer of the local governmental entity where the Work will occur at the same time the "No Trespassing" signs are posted:
 - a. The precise location of each area that is posted "No Trespassing"
 - b. The date and time that each Site was posted "No Trespassing"
 - c. The date, time, description and duration of the Work to be performed at each Site
 3. Post a notification at each encampment area at least 72 hours prior to performing Work in areas containing encampments (such as tents, makeshift dwellings, sleeping sites, or accumulations of personal property that are not refuse). Each notice shall:
 - a. Be weather resistant, and written in both English and Spanish
 - b. Be affixed to each dwelling or post mounted within 10 feet of each encampment
 - c. State the Prime Contractor's business name as the entity performing the work as required by the Sound Transit
 - d. Provide the date that the notice is posted
 - e. Provide the date(s) and time(s) that cleanup will occur
 - f. Provide the telephone number, business hours and physical address of the location where stored personal property may be claimed.
 - g. State that personal property will be stored for 70-days from the date of removal, and if unclaimed within that time, will be disposed of.
 4. At the same time that notifications are posted at encampment areas, provide written notification of the schedule to perform Site cleanup to the Resident Engineer and to the affected homeless advocacy groups as identified by Sound Transit.
 5. Acceptance of signs and notifications will be based on visual inspection that the sign and notifications meet their requirements.
 6. Maintain no-trespassing signs near the construction Site or locations of the construction activity for the duration of construction.
- D. Site Cleanup of Biological and Physical Hazards

1. Provide necessary training of personnel, on and offsite preparations, and safety equipment to complete initial cleanup and disposal of the biological and associated physical hazards. Perform the Work using trained personnel.
2. Proceed with initial Site cleanup and clearing of the Site, once the 72-hour public notification period has passed. If aggressive or violent individuals are encountered, notify the local law enforcement agency to assist in clearing people from the area when necessary. Responsible for all enumerated activities therein in relation to this Project, unless otherwise directed by the Resident Engineer.
3. Perform an initial cleanup of the Project area, which includes all preparatory work required to make the Project area sanitary and safe in accordance with applicable laws, and to address all biological and physical hazards present
4. Refuse generated by the Site cleanup shall become the property of the Contactor and removed from the project. Personal property shall be handled as required by this Specification and applicable laws.

E. Removal, Storage, and Return of Personal Property

1. Personal Property:
 - a. May include radios, audio and video equipment, sleeping bags, tents, stoves and cooking utensils, lanterns, flashlights, bed rolls, tarps, foam, canvas, mats, blankets, pillows, medication, personal papers, photographs, books and other reading materials, luggage, backpacks or other storage containers, clothing, towels, shoes, toiletries and cosmetics, clocks and watches, and eye glasses.
 - b. Does not include building materials such as wood products, metal, or rigid plastic.
2. Personal property items that are not refuse, contaminated, illegal or hazardous shall be removed from the Work area and stored at a location near the Project Site for return to the property owner.
 - a. Items shall be placed in large transparent plastic bags and stored in a manner that protects them from adverse weather and theft.
 - b. Reasonable efforts shall be made to place all items from each encampment into a separate bag. Each bag shall be labeled with an inventory to include a brief description of the contents, a description of the location that it was removed from, and the date that it was removed from the Work area.
 - c. The Contractor shall not open closed items of personal property unless, in its determination, it is necessary to do so to protect public safety.
3. The Contractor shall retain the property for 70 days.
4. If the name and contact information of the owner of a personal property item is identified on that item, then for a period of not less than 10-days after removing the property from the Work area, the Contractor shall attempt to notify the apparent owner of the property and make arrangements for the owner to claim the property.
5. The Contractor shall release the property to any individual who claims ownership provided they are able to establish ownership by identifying the property and its approximate location. The Contractor shall maintain a record of all property that is claimed. The record shall include a description of the property, the date claimed, and the name of the claimant.

6. If personal property is not claimed within 70-days of removal from the encampment, then the property shall become the property of the Contractor and shall be removed from the project.

F. Site Preservation

1. On a daily basis and prior to performing any Work in areas where pedestrians or encampments may be present, the Contractor shall verify that the Work area is cleared of all persons not associated with the project.
2. If the Work Site becomes unsanitary or unsafe due to new encampments or new biological and associated physical hazards after initial cleanup is completed, then the Contractor shall perform additional Site assessment, additional notification and additional cleanup.
3. The Resident Engineer may authorize additional Site preservation measures. The nature and frequency of these measures will be as agreed to by the Resident Engineer. Additional Site preservation measures may include the use of fencing, lighting, or security, provided it is approved in advance by the Resident Engineer. Work performed without Resident Engineer authorization will not be eligible for payment.

3.04 FINAL SITE CLEANUP

- A. Prior to final inspection, clean the entire Site. Remove from the entire Site all construction equipment and facilities, construction waste and unused materials, loose rock and stones, excess earth, and debris of all description resulting from the Work.
- B. Wash, scrub clean, and use a street sweeper where necessary for all pavement and paved walks.
- C. Remove mortar droppings from concrete work and pavement where they occur. Wash and scrub clean all exposed vertical surfaces of concrete.
- D. Clear and clean all manholes and drainage systems.

3.05 WASTE MANAGEMENT - PLAN IMPLEMENTATION

- A. General: Identify materials and provide methods for material separation, handling, containers, storage, signage, transportation, and other items as required to implement waste management.
- B. Designate and label specific areas on Project Site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.06 RECYCLING DEMOLITION AND CONSTRUCTION WASTE

- A. Recycling and Salvaging Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- B. Preparation of Waste: Prepare and maintain reusable, salvage, or recyclable 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.
- C. Procedures: Separate reusable, salvageable, and recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project Site to the maximum extent practicable according to approved waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable materials until removed from Project Site. Include list of acceptable and unacceptable materials at each container and bin. Inspect and remove contaminated materials if found.
2. Provide separate containers for non-recyclable materials (debris destined for disposal), clearly labeled as "Garbage."
3. Stockpile processed materials on Site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water.
4. Do not store materials within drip line or critical root zone of remaining trees.
5. Remove recyclable materials from Sound Transit's property and transport to certified recycling receiver or processor within 30 days unless otherwise approved by the Resident Engineer.

3.07 RECYCLING DEMOLITION MATERIALS

- A. Concrete: Transport concrete to concrete recycling facility.
- B. Concrete Masonry: Transport masonry to masonry recycling facility.
- C. Brick Masonry: Transport masonry to masonry recycling facility.
- D. Metals: Separate metals into "metal only" containers if sufficient space exists.
- E. Wood Materials: Separate unpainted lumber, engineered wood products and panel products into "wood only" container if sufficient space exists. Transport to wood recycling facility. Dispose of painted and treated wood materials.
- F. Asphalt Shingle Roofing: Separate asphalt shingles into separate container for recycling at appropriate recycling facility.
- G. Mixed Materials: Collect remaining materials after separation of the above materials in commingled recycling containers for processing by a certified / permitted C&D recycling facility.
- H. Asphalt Paving: Transport paving to asphalt-recycling facility.

3.08 RECYCLING CONSTRUCTION MATERIALS

- A. Packaging:
 1. Cardboard and Boxes: Separate and recycle per local regulations.
 2. Polystyrene Packaging: Separate and recycle per local regulations.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project Site. For pallets that remain on Site, reuse as appropriate or 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: Separate into "wood only" container if sufficient space exists.

- C. Separate the materials below into material specific container, if space at Project Site allows, or sort into commingled container for mixed C&D debris:
1. Metals
 2. Concrete
 3. Masonry
 4. Carpet
 5. Acoustical Ceiling Tile
 6. Glazing
 7. Styrofoam (white EPS)

3.09 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project Site and legally dispose of them in a landfill or incinerator. Do not allow waste materials that are to be disposed of accumulate on Site.
- B. Burning: Do not burn waste materials on Site.

END OF SECTION

EXHIBITS

Exhibit A: Example Waste Management Progress Report

SECTION 01 74 00 - EXHIBIT A

EXAMPLE WASTE MANAGEMENT PROGRESS REPORT

Generation Point: (project address)		
Time Period: (dates)		

Material Description	Unit	Total Qty of Waste to date (A)	Qty Reused to date(B)	Qty Salvaged to date (C)	Qty Recycled to date (D)	Total Qty Waste Recovered to date (E=B+C+D)	Total Qty Waste Recovered % to date (E/A x100)	Total Waste Disposed to Landfill to date	Actual Handling and Collection Method Used (See Codes)	Disposal Facility
Required Recovery:										
Asphalt paving										
Asphalt roofing shingles										
Brick										
Cardboard (uncontaminated)										
Carpet										
Concrete										
Metals										
Scrap gypsum (new construction only)										
Uncontaminated plastic sheet and film										
Wood (readily recyclable - unpainted and untreated)										
Recommended Recovery:										
Uncontaminated paper packaging										
Uncontaminated boxes										
Uncontaminated polystyrene packaging										
Uncontaminated wood crates										
Concrete reinforcing steel										
Concrete masonry units										
Structural beams and columns										
Structural and miscellaneous steel										
Vertical timbers										
Glu-lam beams										
Wood studs/joists										
Plywood and oriented strand board (OSB)										
Wood paneling										
Wood trim										
Wood decking										
Rough hardware										
Insulation										
Interior doors and frames										
Exterior doors and frames										
Exterior wood windows										
Stained glass windows										
Vinyl windows										
Door hardware										
Glazing										

SECTION 01 74 00 - EXHIBIT A
EXAMPLE WASTE MANAGEMENT PROGRESS REPORT (CONTINUED)

Material Description	Unit	Total Qty of Waste to date (A)	Qty Reused to date(B)	Qty Salvaged to date (C)	Qty Recycled to date (D)	Total Qty Waste Recovered to date (E=B+C+D)	Total Qty Waste Recovered % to date (E/A x100)	Total Waste Disposed to Landfill to date	Actual Handling and Collection Method Used (See Codes)	Disposal Facility
Gypsum board										
Metal studs										
Acoustical tile and panels										
Carpet pad										
Demountable partitions										
Equipment										
Elevator equipment										
Cabinets										
Sprinklers										
Plumbing fixtures										
Plumbing piping										
Plumbing supports and hangers										
Plumbing valves										
Mechanical equipment										
Refrigerants										
Electrical conduit										
Copper										
Copper wiring										
Lighting fixtures										
Lamps										
Electrical ballasts										
Electrical devices										
Switchgear and panelboards										
Transformers										
(Insert other materials as necessary)										
TOTAL:										

Codes:
1 - Reuse of building or other materials on site (i.e., crushing asphalt/concrete for subbase or grinding for mulch)
2 - Salvaging building materials or fixtures at an off-site salvage or re-use center (i.e., lighting, fixtures)
3 - Recycling source-separated materials at an off-site recycling center (i.e., scrap metal or landscaping)
4 - Recycling commingled loads of C&D materials at an off-site mixed debris recycling center or transfer station
5 - Disposal at a landfill or transfer station
6 - Other (please describe)

END OF EXHIBIT

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for providing the following:
 - 1. O&M Manual Log
 - 2. Preliminary O&M Materials
 - 3. Posted Operating and Maintenance Instructions
 - 4. Final Operation and Maintenance Manuals
 - 5. Manual Revisions
 - 6. Renewal Parts Catalog
 - 7. Illustrated Parts Catalog

1.02 SUBMITTALS

- A. O&M Manual Log
- B. Preliminary Operation and Maintenance materials must be submitted within 60 days of individual acceptance of Product Data Submittals.
 - 1. Submittals for:
 - a. Facilities
 - b. Systems
- C. Posted Operating and Maintenance Instructions
- D. Renewal Parts Catalog
- E. Illustrated Parts Catalog
- F. Startup and Testing Plan
- G. Final Operation and Maintenance Manuals

1.03 O&M MANUAL LOG

- A. The Log must be submitted to the RE and approved by Sound Transit prior to the 4th scheduled Transition to Operations meeting after 100% Design.
- B. The Log shall be updated at least 5 days prior to the scheduled Transition to Operations Meeting.
- C. The Log shall always be accessible for review by Sound Transit and the Resident Engineer.

1.04 PRELIMINARY O&M MATERIALS

- A. Preliminary O&M Materials will follow the content and formatting requirements detailed in Section 1.06.C.
- B. Electronic versions of the Preliminary O&M Materials will be submitted to Sound Transit for review, comment, and approval.

1.05 POSTED OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide and mount at each location with equipment that needs to be operated or maintained, a printed sheet under framed clear acrylic plastic, giving brief, concise operating and maintenance instructions for items of mechanical, optical, and electrical equipment at that location.
- B. Provide color-coded lubrication charts and lubrication diagrams. Assign different colors to each, when two or more types of lubrication are required on one piece of equipment.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Include instructions of each equipment and its component parts, including but not limited to the following:
 - 1. Manufacturers' certificates
 - 2. Warranties
 - 3. Parts lists
 - a. Critical Parts
 - b. General Parts
 - c. Parts List in Electronic Format must be in an .xml formatted data sheet
 - 4. Descriptive brochures
 - 5. Maintenance and operating instructions for all equipment and systems installed
 - 6. Installation and start-up instructions
 - 7. Installation verification checklist
 - 8. All Commissioning Reports and tests related to the applicable equipment
 - 9. Start-up instructions and checklist
- B. Format and Publication
 - 1. One Paper Hardcopy O&M Manual shall be provided, one electronic file shall be provided, and one exact replica of all software programs shall be provided.
 - 2. Standard sized manuals shall be reproduced on pages that are 8-1/2 by 11 inches. The binder cover shall be 10-inch to 10-1/2-inch wide (depending on ring size) and 11-1/2 inches to 12 inches high. The binders shall not exceed 3-inch overall thickness. Punched holes shall be on 3/4-inch centers. Folded pages will be permitted (11 inches by 17 inches, "Z" - folded) where the information to be conveyed cannot be presented clearly on single pages. Manuals for 8-1/2-inch by 11-inch pages shall be divided into multiple volumes if the required material cannot be accommodated within the maximum binder thickness, natural breakpoints in

the manuals need to be maintained when multiple volumes of the manuals are provided. Approval by Sound Transit of the final versions is required prior to printing and publication.

3. All covers shall be approximately 1/16 inch thick, resistant to oil, moisture, and wear, to a high degree commensurate with their intended uses. Final sets of manuals shall be serialized with numbers to be supplied by Sound Transit. The numbers shall be permanently marked on the spine of the cover.
4. Loose-leaf metal binder rings with locks shall be used to prevent undesired opening and to provide positive engagement when closed. Diagrams and illustrations shall not be loose or in pockets.
5. Electronic Files
 - a. Electronic file shall be a duplicate of the hard copy publication, provided in .PDF format as one (1) file, with bookmarks used in lieu of tabs, for easy identification and reference. Electronic file will be labeled to identify Project Name, name and function of equipment, manufacturer's identification number, and Contract Specifications number and title, as shown on the title page of the hard copy publication. PDF must be searchable, and have the applicable markers and identical documentation that is provided above in Section 1.06.B
6. Publication
 - a. Printed material shall be clearly reproducible by dry copying machines. This precludes the use of halftone illustrations. Line drawings are required. Printed material shall be double-sided where practical.
 - b. Supply master reproducible copies of all documents. The quality of the master shall be such that duplicates may be made of the same quality as the original, approved submittals.
 - c. All documents or drawings shall be in English language only. All dimensions given in metric units shall also state the English unit equivalents in parenthesis next to the metric dimensions.
 - d. Paper on 20-pound bond white paper, 8-1/2 by 11-inch pages in size or folded to that size and placed in a three-ring binder filled to no more than 2/3 of its capacity. Tab for easy identification and reference.
7. Software
 - a. An exact replica of the installed equipment software for the applicable equipment (i.e., BMS, VMS, etc....) shall be provided.
 - b. Integrated Automation - Software and Documentation (for Design-Build and Systems Contracts)
 - 1) Compile a complete and current set of application software necessary to operate or maintain the system in accordance with the Contract Documents.
 - 2) Build System Databases from compiled documentation and on-Site verification:
 - a) Hardware Component Database: Computers and field controllers.

- b) Software Component Database: Off-the-shelf and application-specific software installed on hardware components.
- c) Monitored/Controlled Equipment Database: Equipment and devices monitored and controlled.
- d) Points List Database: Comprehensive list of data points exchanged including real I/O and logical I/O from field controllers.

c. All Sound Transit IT protocols for Information Security must be followed.

C. Contents of Manual(s)

1. Include a title page, table of contents page with cross-reference between volumes, frontispiece, a list of Subcontractors and Suppliers and their respective contact information, and information covering description, installation, operation, preventive maintenance, corrective maintenance, overhaul, parts list, a list of recommended spare parts, an .xml file must be provided for spare parts in electronic format, and as well as an appendix as described in 1.06 C. 11.
 - a. Include on the title page, the name and function of the equipment, manufacturer's identification number, and the Contract Specifications number and title.
 - b. The Table of Contents shall list all sections and subsection titles of the Manuals with reference to the page on which each starts and a list of included drawings.
 - c. Frontispiece shall be a recognizable illustration of the equipment described in the Manuals.
2. Manufacturer
 - a. Provide a clear and legible copy of manufacturers' certificates, as accepted by Sound Transit.
3. Warranty table of contents with an index, listing equipment/materials, term and expiration date.
 - a. In reference to Project Requirements.
 - b. Expiration date shall be 1 year from project acceptance or last repair, whichever is most recent.
 - c. Preliminary expiration date at time of Submittal
 - d. Product Data, approximate quantities installed of typical maintenance items (e.g., Lights)
 - e. Shop drawings
4. Descriptive information including drawings and diagrams, and a physical and functional description of the equipment, and major assemblies and subassemblies
5. Installation information and pre-installation inspection, installation, calibration, and preparation for operation: Both for initial installation and for re-installation after overhaul.

6. Operation information including, but not limited to: Step-by-step procedures for starting, restarting, operating, shutdown, and emergency requirements. Include the information on performance specifications and operating limitations.
7. Modification of manual contents to the appropriate environment: For example, if a product that is typically installed in a building is installed in an underground tunnel, customize the standard manual and describe the operation and maintenance for that particular environment.
8. Maintenance information, including, but not limited to, step-by-step procedures for inspection, testing, operation checks, cleaning, lubrication, adjustments, repair, overhaul, disassembly, and reassembly of the equipment for proper operation of the equipment. Include a list of special tools that are required for maintenance with the maintenance information.
9. Provide the complete parts list, exploded diagrams containing lowest level replaceable parts, and a list of recommended spare parts with all necessary information, including part numbers and catalog item numbers if applicable, for identifying parts. Identify parts or assemblies obtained from another manufacturer by the name of that manufacturer and its identifying part number. Supply the size, capacity, or other characteristics of the part. The material in the maintenance manuals and parts catalogs shall be organized and indexed, with a standard numbering system.
10. Provide the manufacturer's recommendations for a preventive maintenance schedule and procedures. This should include any daily, weekly, monthly, quarterly, semi-annual, annual to meet the expected life for each piece of the equipment.
11. Include in the appendix safety precautions, a troubleshooting tree, a glossary, and, if available at time of Submittal, copies of test reports, final set points, and other relevant material not specified to be submitted.
12. Delete all information from O&M Manuals on material or equipment not used in the Work from the O&M Manuals.

1.07 MANUAL REVISIONS

- A. Up until Acceptance, if subsequent modifications to the equipment require revised operation and maintenance procedures:
 1. Revise the O&M Manuals to show the equipment as installed.
 2. Revise by issuance of replacement pages to the final O&M Manuals, or by reissue of the O&M Manuals, at Contractor's option.
 3. Following the issue of each publication, provide revised table of contents and pages covering all changes, whether required by change of design, or procedures, or due to error. Submittals of revised pages shall be accompanied by an updated revision record for each manual documenting date revised, page number, effective date of the revision, a description of the change, and the reason for the change. Manual and catalog revisions shall be supplied to Sound Transit before, within 30 days of the arrival of the altered parts or components.
 4. Submit the revisions to the O&M Manual not later than 30 days following revision of the equipment. Submittal of revisions will be subject to Standard Submittal review process, submitted as a subsequent revision to the previously approved revision.

5. These revisions shall be kept current (revised every 6 months or less) during the warranty period. After the warranty period, revisions shall be supplied to Sound Transit every 6, 9, or 12 months for a period of 2 additional years. Changes affecting safety, safe maintenance, or operation shall be supplied as soon as they are discovered.
- B. Provide a revised manufacturers recommended maintenance schedule in both graphic and list form. Provide separate schedules for: Guideway/Track/Systems, Stations/Transit Centers, and Parking Garages. Cross reference the Maintenance Manual. Provide both an editable electronic source file and a hard copy. The maintenance schedules are to include:
 1. Consolidated manufacturer recommended service, maintenance procedures, inspections, equipment sub-component replacement etc., to the expected end of product or equipment service life date or 10 years, whichever is shorter. Address, mechanical, electrical, plumbing, fire protection, architectural, structural, civil, landscape, systems, etc., elements of the project.
 2. Identify if any changes in equipment requires additional or revised jurisdictional inspections, operating permits, licenses etc. Notify Sound Transit if needed and ensure such additional or revised inspections, permits, licenses, etc., are received as of the date of substantial completion.

1.08 RENEWAL PARTS CATALOG

- A. Enumerate and describe every component with its related parts, including Supplier's number, Contractor's number, Drawings Apparatus Reference number, and provision for entry of Sound Transit part number.
- B. Use cut-away and exploded drawings to aid identification of parts not readily identified by description.
- C. Parts common to different components, for instance, bolts and nuts, must bear the same Contractor's number with a reference to other components in which they are found.
- D. Identify each part or component as being part of the next assembly.
- E. Commercially available items such as common standard fastenings, fuses, lamps, and fittings, must be identified by standard hardware nomenclature besides Contractor's number. Provide a separate list of these items in the catalog with adequate information to order these items through commercial channels.
- F. Provide a complete itemization of servicing materials (such as oils, paints, special compounds, and greases) required and component requiring its use.
- G. Provide ordering and procurement information required for components and subassemblies to the lowest level replaceable component.
- H. Submit lists in the form of reproducible Bills of Materials suitable for loose-leaf binding adequately cross-referenced to related drawings and Bills of Material.

1.09 ILLUSTRATED PARTS CATALOG (IPC)

- A. The Illustrated Parts Catalog (IPC) describes and illustrates all the replaceable assemblies following a general "*Top-Down Breakdown*" concept, starting with the top assembly, and proceeding downward through its various sub-assemblies, components, and detail parts to the lowest replaceable unit. This arrangement enables the user to start with the completely assembled (top) major groups and follow each down to the unit, or to reverse the procedure.

- B. Each part illustrated shall include a corresponding number on a related part listing in general disassembly sequence down to the lowest replaceable part. The listing will provide complete identifying information on each item. This format is designed to aid the user in readily identifying and ordering replacement parts to support proper maintenance of the equipment. The IPC submittal will be in PDF format.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SPECIAL SUBMITTAL PROCEDURES

- A. In a meeting convened by Sound Transit, the Contractor and affected Subcontractor and equipment Supplier shall review and identify corrections, which are necessary to the O&M Manuals.
- B. Revise manuals in accordance with directions and comments from both meeting inputs and formal mark-ups (by reviewers).
- C. Resubmit as required

3.02 SOUND TRANSIT RESPONSIBILITY

- A. Upon completion of all Contractual training and receipt of all Contractual spare parts, and the project is issued acceptance, Sound Transit will determine an operational care and custody date in which Sound Transit will be responsible for operation, adjustment, and maintenance of all permanent equipment and systems.
- B. Sound Transit will convene an instructional meeting before Substantial Completion, with the Contractor, affected Subcontractor and equipment or material manufacturer, and the O&M personnel before final inspection or Acceptance, to review the contents of the O&M manuals with Contractor's personnel.
- C. After Acceptance, Sound Transit will designate operating and maintenance personnel who will be responsible for operation, adjustment, and maintenance of all equipment and systems.

END OF SECTION

SECTION 01 78 36
WARRANTY MANAGEMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies general requirements for Warranty Management.

1.02 SUBMITTALS

A. WARRANTIES

1. A draft of all required warranties shall be submitted to Sound Transit for approval prior to Substantial Completion.
2. When Operating and Maintenance Manuals are required for warrantied construction, a draft copy of each required warranty shall be provided, as necessary, with each Operating and Maintenance Manual.

B. WARRANTY PLAN

1. The Contractor shall prepare and submit a Warranty Plan no less than 90 days prior to Substantial Completion which outlines the responsibilities and procedures to address warranty issues arising from the Contract and the Work. The Resident Engineer has the right to shorten this time period based on project duration.
2. Prior to Substantial Completion, the Contractor shall meet with Sound Transit to develop a mutual understanding with respect to the requirements of the Warranty Plan. Communication procedures for notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by Sound Transit for the execution of the warranty shall be established and reviewed at this meeting. Based on the information provided at the meeting, the Contractor shall submit to Sound Transit a written Warranty Plan.
3. The Warranty Plan shall include the following information.
 - a. The Warranty Plan shall include all the warranty information required to assure that Sound Transit receives all warranties to which it is entitled including:
 - 1) Key personnel associated with the warranty management process, to include their specific roles and responsibilities, and their telephone numbers and other means of contact.
 - 2) Key personnel should be from within the organizations of the Contractor, subcontractors, manufacturers, and suppliers involved.
 - b. The Contractor may choose to furnish the name, telephone number and address of a licensed and bonded company, other than itself, authorized to directly initiate and pursue warranty work on its behalf.
 - c. The Plan shall include the draft Warranty Log.

C. WARRANTY LOG AND DOCUMENT SET

1. The Contractor shall populate the Warranty Log included in Appendix A. The log shall contain the following information in an organized fashion for all warranted products, assets, and materials:
 - a. Warrantied Product
 - b. Manufacturer of Product
 - c. Specification Division of Warranty
 - d. Warranty General Description of what is covered. The warranty requirements shall match the requirements in the technical specifications.
 - e. Warranty Length of Time of product covered.
 - f. Date Warranty Commences.
 - g. Date of Warranty final inspection walk
 - h. Contact Information for Warranty Manufacturer.
2. Preliminary Warranty Document Set shall contain the following information in an electronic file format organized in the following manner:
 - a. Warranty Log shall be presented in preliminary condition.
 - b. Product, Asset and Material Warranties shall be listed in digital file listing Division and Description in the File Name.
3. Final Warranty Document Set shall be submitted in final condition upon Acceptance of the Project in prescribed electronic format and in a hard copy format.

1.03 WARRANTY WORK INSPECTION

- A. Sound Transit and Contractor shall jointly inspect work performed under the warranty provisions within two-weeks of repair.
- B. Two (2) months prior to the date warranty expiration, Sound Transit will conduct an inspection of the facility, linear system and/or warranted product. The Contractor shall participate in this inspection.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 39.20
AS-BUILT DOCUMENTS
DESIGN-BID-BUILD & GC/CM

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for the preparation, maintenance, completion and submission of the as-built documents, including any Contract specification changes, as-built drawings, field sketches, record shop drawings, field survey point data tables, and all supporting electronic data.

1.02 DEFINITIONS

- A. Refer to Chapter 2 in the Design Technology Manual for definitions related to the required documents, drawings, and supporting electronic data.

1.03 STANDARDS

- A. Sound Transit Design Technology Manual (DTM): Standards and requirements for all drawings, models, and their supporting electronic data.

1.04 ELECTRONIC FILE FORMATS AND SOFTWARE

A. General

- 1. Contractor must provide all software, access to software, technical and administration support, and training to the Resident Engineer and their designated personnel to conduct reviews and coordinate the competition of the required documents and electronic data.
- 2. Contractor must submit all electronic files in the latest software version unless otherwise approved by the Sound Transit Design Technology Manager.

B. Portable Document Format (PDF)

1. General

- a. Submit in multi-sheet PDF files with the drawings/pages in the same order as provided in the Contract Documents.

2. File Naming

- a. Include in all PDF file names:
 - 1) An underscore (_) between each word with no spaces.
 - 2) The Contract Unit Description (CUD) number, for example, E340.
 - 3) The Contract Unit Description Name, for example, Bel-Red.
 - 4) The type of document, for example, As-Built Specifications.

5) Date of submittal, for example, 05-01-2022.

6) Example: E340_Bel-Red_As-Built_Specifications_05-01-2022

C. REVIT & Civil3D

1. Include all source files and supporting data used to reproduce the drawings.
2. Files and their internal elements must be fully readable and modifiable in the approved software and conform to the standards and requirements in the DTM.
3. File Naming must follow the requirements of the DTM.

D. Excel

1. Contain all data in a Table within Excel.
2. Name each table to represent the content.

1.05 SUBMITTALS

A. Incremental Submission

1. General
 - a. Incremental submissions do not constitute the final submission.
2. Recording
 - a. Contractor must continue recording all subsequent changes to the required documents and supporting electronic data until the completion of construction and submit as part of the final submission.
3. Submissions
 - a. Submit within 14 days of request by the Resident Engineer.
 - b. Must provide 3 submittals of the following documents and their supporting electronic data per 12-month period.
 - c. Submit all documents and supporting electronic data as requested by the RE.

B. Authority Having Jurisdiction (AHJ) Permit Submission

1. General
 - a. AHJ Permit Submissions do not constitute the final submission.
2. Recording
 - a. Contractor must continue recording all subsequent changes to the required documents and supporting electronic data until the completion of construction and submit as part of the final submission.
3. Submission
 - a. Submit within [14] days of request by the Resident Engineer.
 - b. Allow for [1] submittal for each permit.

- c. Allow for [1] submittal for each AHJ utility relocation work on the project.
- d. Submit all documents and supporting electronic data as requested by the AHJ and the RE.

C. Final Submission

1. General

- a. The final submission is the delivery of all required documents, drawings, and supporting electronic data that accurately reflect the final site condition.

2. Recording

- a. Record all changes up to Acceptance.

3. Submittal

- a. Submit within the time frame specified in the Contract Documents.
- b. Submit any additional changes from NCR corrective actions for approval 14 days before Acceptance.
- c. Submit the following documents and their supporting electronic data.
 - 1) Contract Specifications
 - 2) As-Built Drawings
 - 3) Field Survey Point Data Tables
 - 4) Record Shop Drawings

1.06 QUALITY ASSURANCE

A. General

- 1. Contractor must provide a full-time as-built documents individual to lead the maintenance and delivery of the required documents and supporting electronic as well as coordinate with the RE to resolve errors and omissions.
- 2. Contractor must have the Construction Quality Manager, or a licensed Professional Engineer supervise the as-built documents individual.
- 3. Submit a resume for review and approval by the RE 3 weeks prior to beginning of Work.

B. Qualifications

- 1. 5 years prior experience in as-built document management, including:
 - a. Managing as-built documents for a project of comparable size, scope, and complexity.
 - b. Familiarity working with the required documents and data.
 - c. Competency in reading and interpreting markups, sketches, and drafting/modeling changes to design and construction documents.

C. Roles and Responsibilities:

1. Contractor must maintain and coordinate the maintenance, of all required documents and logs until final submission.
2. Maintain a log of all change documents that contribute to a change in the as-built drawings.
3. Review, or coordinate the reviews, of all required documents and their supporting electronic data.
4. Verify completed changes to all documents with field staff monthly.
5. Setup and lead meetings with the RE team and Sound Transit personnel:
 - a. Coordinate any changes to the required documents and their status.
 - b. Review the required documents for completeness and accuracy.
6. Train field engineers to properly update the required documents.
7. Make all required documents available to the RE for review and coordinate any needed corrections monthly.
8. Compile and submit all required documents to the RE for incremental submissions and the final submission.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Contractor must update the as-built drawings, Contract specifications, and record shop drawings with all changes made to the IFC drawings, IFC specifications, and shop drawings, as well as any site conditions encountered during the Work.
- B. Contractor must collect and compile any required survey data.
- C. Contractor must record all Work prior to concealing or covering.
- D. Contractor must make available to the Resident Engineer for review and acceptance every 30 days as part of the pay application review per the Contract Documents.

3.02 CONTRACT SPECIFICATIONS

- A. General
 1. Utilize the ST provided Contract Specifications and maintain them in PDF.
 2. Stamp the front cover of each specification with "As-Built" in red.
 3. Annotate all changes using red markings.
 4. Red markings must be clear and legible.

5. Submit in Portable Document Format (PDF).

B. Recording

1. Record all changes within 30 days.

3.03 AS-BUILT DRAWINGS

A. General

1. Utilize the provided Contract drawings and maintain them in PDF with unflattened markups and annotations. No inserted images or documents.
2. Stamp the front cover of each specification with "As-Built" in red.

B. Recording

1. Mark with color, using the following conventions:
 - a. Red: Information to add.
 - b. Green: Information to delete.
 - c. Blue: Communications, instructions or reference information used to clarify changes (blue annotations will not be transcribed). This may include dimensions and references to other documents.
 - d. Record all changes within 30 days of executed change.

C. Incorporate Revised Contract Drawings

1. Update the as-built drawings with new versions of the contract drawings:
 - a. Add the new version of the drawing to the set.
 - b. Move all previous markups, sketch references, and other annotations to the new version of the drawing.
 - c. Remove the previous version of the drawing.
2. Add only drawings with the project title block and all information included.

3.04 FIELD SKETCHES

A. General

1. Provide field sketches when there is not sufficient space on the as-built drawing, or if the level of change is too complex to provide clearly.
2. Provide change information in either the drawing or referenced sketch without duplication.
3. Submit in PDF
 - a. Include:
 - 1) Labeled cross referenced sketch number in blue.
 - 2) Reference numbering format for a PDF with a single page:
 - a) Sound Transit/ DSDC/ CMC; FSKST-XXXX.

b) Contractor; FSKGC-XXXX.

b. Reference numbering format for PDF with multiple pages:
Sound Transit/ DSDC/ CMC; FSKST-XXXX-1.

c. Contractor; FSKGC-XXXX-1.

B. Recording

1. Add dimensions to accurately locate and orient the objects in the sketch to objects already in the as-built drawings.
2. Create a unique identification number for each field sketch and place the number on the sketch and related as-built drawing.
3. Store all field sketches separately from the as-built drawings.

3.05 RECORD SHOP DRAWINGS

A. General

1. Update all Shop Drawings and models to reflect the final installed Work.
2. Submit in Portable Document Format (PDF).
3. Consolidate drawings into packages per each trade or sub-contractor.
4. Include in all packages:
 - a. Cover sheet with the project title and Contract Number Included
 - b. All installed Work and impacts to the site
 - c. Index
 - d. Legends
 - e. Schedules
 - f. Color codes
5. Locate and orient all information in the required coordinate system.
6. When the Issued For Construction (IFC) Drawings and shop drawings have the same information:
 - a. Update all drawings to reflect an accurate, and complete representation of the final condition and correct any conflicts between them.
7. Submit all Contractor and Sub-contractor models and Federated Model used to create the record shop drawings:
 - a. In their native format
 - b. In the project coordinates and grid layout established in the models that support the IFC drawings.
8. Submit a Federated Model of all models used to support the record shop drawings in .nwd format.

3.06 FIELD SURVEY POINT DATA TABLES

A. General

1. Consolidate all field survey point data into an Excel table documenting the final site conditions and provide in Excel.
2. Include the point number, Northing, Easting, Elevation, and Description for each surveyed item.

END OF SECTION

SECTION 01 79 00

TRAINING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes specifications for training of Operations and Maintenance personnel, Sound Transit, or other agencies in the operation and maintenance of all furnished equipment and systems.
- B. The training program shall train personnel to operate and maintain the furnished equipment and systems to perform in accordance with the requirements of this Contract.

1.02 SUBMITTALS

- A. Training Program Plan: Three hard copies and two electronic copies (one Microsoft Office document and one pdf) of the draft and final versions
 - 1. Draft Version: Submit 6 months before the start of training.
 - 2. Final Version: Submit 1 month prior to the start of training.
- B. Instruction Material: Instructor Guides and Student Handout Packages.
 - 1. Draft Version: Three hard copies and one electronic copy (Microsoft Office document) of the draft version. Submit 1 month prior to the start of training.
 - 2. Final Version: One hard copy and one electronic copy (Microsoft Office document). Submit by Substantial Completion.
- C. Training reports shall be submitted not later than 1 week after completion of training in accordance with the training schedule.

1.03 TRAINING PROGRAM DEVELOPMENT PLAN

- A. Prepare a Training Program Plan describing the training program. Provide complete documentation to substantiate employee certification and course program guides. Include, as a minimum, the following:
 - 1. A flow diagram indicating the logical progression of the training courses
 - 2. A training matrix for each course, including course title, type of instruction, lesson objectives, method of evaluating achievement of each objective, material and equipment requirements, and class duration of each lesson
 - 3. Résumés showing the qualifications of all proposed instructors: The principal instructors shall have previous formal classroom instruction training and relevant experience with the provided systems equipment in an operating environment.
 - 4. A list of all Subcontractors or other equipment manufacturers to be used in the training program and a description of their responsibilities
 - 5. A list of each course's prerequisites (e.g., knowledge of basic electronics)

6. Training Schedule: Develop a complete, detailed training schedule, in consultation with Sound Transit, after Sound Transit's receipt and review.

7. Instructor Guides

1.04 TRAINING PROGRAM: GENERAL

- A. Develop a training program consisting of a logically related sequence of separate courses covering equipment, system, and overall system maintenance of operations.
- B. Develop training that meets requirements Hazardous Waste Operations specified in WAC 296-843.
- C. Include classroom, hands-on or field instruction, as appropriate. Instruct Operations and Maintenance personnel first in the classroom, then with hands-on experience for putting the theoretical classroom training to practical use.
- D. Present classes and instructions in person by a qualified instructor. When prerecorded lectures are part of a training course, have the instructor or a qualified substitute supplement the recorded material. Ensure instructors demonstrate a complete and thorough technical knowledge of the material in the course – that they be thoroughly familiar with handbooks, guides, tools, test equipment, and other aids used in troubleshooting and repairing the equipment.
- E. Schedule training to fully train personnel prior to Substantial Completion, but after acceptance of Operations and Maintenance Manuals and completion of commissioning.
- F. Provide training for up to 30 participants in each training courses.
- G. Training facilities will be provided by Sound Transit.
- H. Schedule training to not interfere with the pre-revenue tests and commissioning of the system.
- I. Schedule training a minimum of two weeks in advance of desired training dates. Schedule training to not exceed 8 hours per day.
- J. Prepare training material appropriate for personnel with only basic skills pertinent to their agency job descriptions. Anticipate personnel who may not have knowledge of features of the subject equipment or systems.

1.05 TRAINING COURSES

- A. System Operations Training: Address the operating procedures of the integrated system. Include an understanding of the overall system operation and provide hands-on experience in operating the systems.
- B. Overall System Maintenance Training: Provide participants with a working knowledge of the system equipment, its operation, interfaces, and use of test equipment. Cover sufficient theoretical background and hands-on experience in troubleshooting and repair procedures to permit participants to locate and repair system faults in a timely manner. Cover all available troubleshooting and debugging techniques.
- C. Equipment Operations and Maintenance Training:
 - 1. For all equipment provided under the Contract, offer training in its operation and maintenance. Provide a thorough knowledge of the equipment, its operation, interfaces with other equipment, its capabilities, and use of related test equipment.

2. Provide participants with theoretical background and hands-on experience in troubleshooting, repair procedures, and preventive maintenance procedures. Include board level troubleshooting, repair and replacement. Have course participants operate equipment and learn how to use test equipment and fixtures to troubleshoot problems and repair failures.
 3. Enable Operations and Maintenance personnel to develop a self-sufficient hardware maintenance team for all the equipment.
- D. Provide additional training, as deemed necessary by the Resident Engineer, due to modification to the systems and equipment made after completion of the training.
 - E. Document training sessions with a sign-in sheet to confirm the training sessions were performed as required.

1.06 MATERIALS

- A. Use reference manuals, operating and maintenance manuals, system documentation, diagnostic manuals and user's manuals as training materials.
- B. Tailor principal documents used for training to reflect all Sound Transit equipment and specific user requirements.
- C. Reference the Operations and Maintenance Manual general version during training.
- D. Provide each course participant copies of training manuals and other pertinent material prior to the commencement of all courses.
- E. Upon completion of each course, instructor's manuals, training manuals, and training aids shall become the property of Sound Transit unless such items are specifically exempted by the Resident Engineer. Sound Transit reserves the right to copy all training materials and aids for Sound Transit use in Sound Transit-conducted training courses.
- F. Throughout the Contract and warranty periods, supply Sound Transit with all changes and revisions to the training manuals and other documentation.
- G. Provide all special tools, equipment, training aids, and all other materials required to train course participants. Provide an adequate number of special tools and other training equipment for the number of participants attending the course.
- H. Use actual hardware and photographs taken during the manufacturing process wherever possible. Ensure actual hardware used for training passes re-inspection and acceptance testing prior to being placed in service.
- I. Sound Transit shall have the right to video any and all training courses presented and to use these videotapes to train personnel in the future.

1.07 INSTRUCTION MATERIAL

- A. Instructor Guides and Student Handout Packages
 1. Include: Course title, agenda, schedule, document list (such as manuals), training aids (such as handouts), and the presentation.
- B. The presentation portion of the Instructor Guide shall be detailed enough to:
 1. Serve as a written record of the specific facts and information.
 2. Allow another instructor with knowledge of the area to teach the class.

3. Allow replication of all evaluations, tests, and quizzes given in conjunction with this lesson.

C. The student handout package shall include all material referenced in the lesson.

1.08 TRAINING REPORTS

A. Establish a grading system for approval by Sound Transit to report the progress of each trainee during a course. Grading shall be kept strictly confidential and furnished only to personnel in Sound Transit that are designated by the Resident Engineer. The grading system shall identify all requirements for further training for each participant.

1. Include graded tests (without names) with raw scores.
2. Include a summary of the results of monitoring and evaluating as well as records of student attendance and performance.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 91 13

GENERAL SYSTEMS TESTING AND COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Purpose:

The purpose of the Testing and Commissioning Requirements is to establish the process for verifying that the systems have been installed in the prescribed manner and will perform in accordance with Sound Transit's project requirements. Adherence to the testing and commissioning process is a contractual obligation which will verify and document the quality of the system during testing and start-up and aid in the orderly transfer of equipment and systems into operational service to be used by Sound Transit.

B. Scope:

This Section includes general requirements for:

1. The Testing and Commissioning process including defined testing levels.
2. The Testing and Commissioning Plan, which includes the procedures, management, coordination, scheduling, execution and documentation of testing and commissioning work.
3. Performance of testing and commissioning testing and troubleshooting of equipment and systems.
4. Qualifications of the technical staff to perform and oversee the testing and commissioning activities.
5. Technician services requiring the use of tools or test equipment to perform the testing and commissioning work and to test adjust or otherwise bring equipment into a full operational state.

C. Testing and Commissioning work includes, but is not limited to:

1. Scheduling and coordination of testing and commissioning work.
2. Preparation of submittals.
3. Installation verification and documentation of components, and equipment to be commissioned.
4. Providing all necessary tools, instruments, equipment and personnel for Commissioning Tests.
5. Performing testing and commissioning activities including Systems integration testing to verify readiness for service.

6. Correcting issues and repeating testing and commissioning activities when results do not meet acceptance criteria.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00, Submittal Procedures.

B. Testing and commissioning.

1. Testing and Commissioning Manager: Contractor must submit a resume documenting the following qualifications of the proposed candidate to Sound Transit for approval. Sound Transit, prior to approval, may elect to interview the candidate.

a. Employment History

- 1) Present position, title, job description and employer details
- 2) History of employment (include companies, dates and positions held), description of work on projects which qualifies the individual for the position
- 3) Education and technical training

b. Employment History/Qualifications:

- 1) Minimum ten (10) years of experience in Start-up and troubleshooting complex mechanical and electrical systems of similar complexity to those contained in these documents and their interface with other building equipment and Systems.
- 2) Good working knowledge of complex environmental and electric power control and facility management Systems: Capability of understanding control vendor's operating System and control code; Capability of troubleshooting control code and recommending necessary modifications.
- 3) Experience writing Testing and Commissioning Activity Procedures similar in complexity and level of detail required by this Contract.
- 4) Excellent communication and writing skills, meeting facilitation skills, organizational skills, and ability to work well with management and trades contractors
- 5) Experience with managing, scheduling and coordinating complex acceptance and verification work of multiple Subcontractors: Demonstrated ability to coordinate and schedule work of multiple contractors, integrated with other construction activities. Provide samples of work products that demonstrate day-by-day coordination and scheduling skills.

2. Testing and Commissioning Plan

3. Testing and Commissioning Schedule - Contractor may choose to submit this as part of CPM Schedule. Refer to 01 31 13.10.

4. Level 1 Testing and Commissioning Activity procedures and test forms for the following:
 - a. Factory Acceptance Testing
 - b. Installation Verification checklists
 - c. Static Test procedures and test forms
 - d. Start-up requirements, procedures, and test forms
 - e. Component Testing and Commissioning tests
 - f. Equipment Testing and Commissioning tests
 - g. System Testing and Commissioning tests
5. Level 2 Testing and Commissioning Activity procedures and test forms for Intra-Facilities System Interface Testing (Field System Tests) and Commissioning Tests.
6. Level 3 Testing and Commissioning Activity procedures and test forms for the following:
7. Inter-Facilities Interface Tests (Systems Integration Testing)
8. Testing and Commissioning Certificate of Conformance (for Level 3 to start): Submit within 14 days after the completion of Testing and Commissioning work is completed prior to Level 3 testing
9. Final Testing and Commissioning Report: Submit within 14 days after the completion of all Level 1, 2 and 3 activities.

C. Systems Integration

1. Systems Integration Test Manager/Integrated Test Lead: Contractor must submit a resume documenting the following qualifications of the proposed candidate to Sound Transit for approval. Sound Transit, prior to approval, may elect to interview the candidate. Resident Engineer reserves the right to interview the Systems Integration Test Manager/Integrated Test Lead candidate in person prior to accepting placement in the position. Final approval of the Systems Integration Test Manager/Integrated Test Lead will be by Resident Engineer.
 - a. Employment History
 - 1) Present position, title, job description and employer details
 - 2) History of employment (include companies, dates and positions held), description of work on projects which qualifies the individual for the position
 - 3) Education and technical training
 - b. Employment History/Qualifications:
 - 1) Minimum ten (10) years urban transit environment experience in testing, start-up and troubleshooting systems

of similar complexity to those contained in these documents.
Knowledge of testing procedures.

- 2) Demonstrated ability to coordinate and schedule work of multiple contractors, integrated with other construction activities. Provide samples of work products that demonstrate day-by-day coordination and scheduling skills.
- 3) Experience demonstrates a proven ability to collaborate with Civil contractors, subcontractors, suppliers, engineering leads and the owner to create testing plans for the verification, and validation activities, such as determining verification methods or simulation test cases.
- 4) Knowledge of selection, application, and use of field calibration grade equipment and instrumentation for measuring equipment and system performance.
- 5) Have ten years of experience as a System Test Manager and Systems Integration Test Manager, or comparable role, performing testing and commissioning of systems of similar complexity to those contained in these documents.
- 6) Have extensive knowledge of System Integrated Test Procedures.

c. Experience with managing, scheduling and coordinating complex acceptance and verification work of multiple Subcontractors.

2. System Integration Test Plan (SITP); Submit at least 12 months before the start of SIT Testing.
3. System Integration Test Procedures; Submit at least 6 months before the start of the SIT Testing.
4. System Integration Test Reports; Submit within 7 days after the completion of system integration tests.

1.03 TRANSMITTALS

- A. Testing and Commissioning Manager Letter of Authority: Within 10 days after approval of the Testing and Commissioning Manager resume and qualifications.
- B. Testing and Commissioning Activity weekly/monthly reports.
 1. Installation Verification report: Prior to Start-up of a System, transmit Installation Verification report.
 2. Monthly Testing Summary: Transmit monthly beginning with first factory test submittal.
 3. Monthly Issues Log update: Transmit monthly beginning with first factory test submittal.
 4. Three-week look ahead Testing and Commissioning Schedule; Transmit weekly

5. Weekly Testing and Commissioning Progress Report: Transmit on the first day of the week following the week in which Testing and Commissioning Activities are conducted. Include information for Testing and Commissioning Activities conducted since the preceding report:
 - a. Testing and Commissioning Activity number including identification of components, assemblies, equipment or Systems
 - b. Activity date
 - c. Submittal date
 - d. Apparent activity status: Acceptable or not acceptable results, in the opinion of the Testing and Commissioning Manager.
 - e. Testing and Commissioning Activity data: Within 3 days after completion of each test
 - f. Testing and Commissioning Activity test forms, signed and dated.
 - g. Provide data trend logs when specified for individual Testing and Commissioning Activities.

PART 2 - SYSTEMS TESTING AND COMMISSIONING AND SYSTEMS INTEGRATION TESTING PROCESS

2.01 OVERVIEW OF THE TESTING AND COMMISSIONING PROCESS

- A. Requirements Based Process: To demonstrate meeting the contract requirements, and those required by Authorities Having Jurisdiction and Sound Transit, the testing and commissioning process shall be structured as requirements-based to demonstrate that criteria and functionality is achieved at each level of testing.
 1. The Contractor is responsible to test and commission all installed equipment and it's remote monitoring and control as applicable. At a minimum, equipment and Systems shall be subject to the testing levels defined in section 2.02 below.
 2. The Testing and Commissioning Plan shall be multi-leveled, structured from factory to field, and progressed through increasing levels of complexity from component to subsystem to system-level testing as defined below.
 3. The Testing and Commissioning Plan shall define the interfaces between the system elements to be commissioned under this contract and those in operational service on Sound Transit facilities. Specific procedures to manage these interfaces without impact to operations shall be included in the Plan.
 4. The Testing and Commissioning Plan shall define the interfaces between the system elements to be commissioned under this contract and those being installed and commissioned by other contractors or Agency personnel and develop procedures for testing these interfaces.
- B. The Contractor assumes sole responsibility for the planning and safe execution of all testing and commissioning activities.

The Contractor shall:

1. Ensure that all tests are carried out in a manner such that adverse impacts on Sound Transit assets or operations do not result.
2. Ensure that the testing is performed in a safe and effective manner and shall be responsible for the progressive levels of testing and final acceptance into operational service of all new or modified equipment installed under this contract.
3. Be responsible for testing the equipment installed under this Contract in order to demonstrate that the equipment will operate as specified and can be monitored or controlled remotely as required by Sound Transit's Link Control Center (LCC) and back-up LCC.
4. Be responsible for coordinating and providing all procedures, equipment, instruments and personnel required to complete the required testing.

2.02 TESTING AND COMMISSIONING ORGANIZATION OF LEVELS

A. The Testing and Commissioning Plan shall be organized in a progressive fashion to clearly define the testing process in the following categories. Each component, subsystem and system to be tested shall be associated with one of the Levels defined below. A full definition of these levels can be found in the latest Systems Integration Test Program (SITP).

1. Level 1 Testing and Commissioning activities:
 - a. Factory Acceptance Testing: Activities numbered xxxx-FAT-xx. The Factory Acceptance Testing (FAT) shall demonstrate that each System as a whole and each of its subsystems and components meets all requirements, including functional and non-functional requirements.
 - b. Installation Verification: Activities numbered xxxx-IV-xx. Procedures to confirm material and equipment is installed in accordance with Contract requirements. (see additional information in 3.08.1)
 - c. Static Test: Activities numbered xxxx-ST-xx. Procedures to test the integrity of installed elements.
 - d. Start-up: Level 1 Testing and Commissioning: Activities numbered xxxx-SU-xx. Procedures used to bring equipment or systems from a state of complete installation to powered operation. Verify capacity, control, and coordinated response of materials, components and equipment that comprise a system to a variety of conditions and loads in accordance with specified sequences of control.
 - e. Component Tests: Activities numbered xxxx-C-xx. Tests of the controllability, functionality and calibration of individual instrumentation, components, monitoring and control devices. Verify installation, calibration, adjustment and response under a variety of conditions important to the required performance of associated equipment and systems.
 - f. Equipment Tests: Activities numbered xxxx-E-xx. Tests of the controllability, functionality and capacity of individual assemblies or items of equipment including, but not limited to, items identified in equipment schedules.

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Factory Acceptance Tests for SCADA prior to field deployment. Testing shall include functionality at both the Link Control Center (LCC) and the back-up control center.

- 4) Level 3 includes the testing to support the Sound Transit System Integration Test Plan (SITP). Further information for the SITP is shown in Section 3.04 below.

4. Level 4 Testing and Commissioning Activities

- a. Pre-Revenue Operations/Simulated Service Tests: Testing and Commissioning Activities that are conducted to simulate revenue service operations
 - 1) Pre-Revenue Operations simulate normal and abnormal conditions, including emergencies, and progressively stress test the functionality of the installed systems.
 - 2) Simulated service tests will be conducted by Sound Transit prior to opening of the service. The simulated service conducted during the pre-revenue service phase provides additional System validation. The Contractor shall support the simulated service tests per milestone and contract dates.
 - 3) Sound Transit will verify proper training of operations staff during this level.
 - 4) Sound Transit will perform operations during Pre-Revenue Service that are intended to stress test the system including service at peak headways for extended periods of time. The Contractor shall provide technical personnel for; monitoring the system performance during Pre-Revenue Service; troubleshooting; and repairing issues as required. The Contractor shall be responsible for all access permits, coordination with Operations, and performance of required work.
 - 5) Sound Transit will perform emergency drills with the Authorities Having Jurisdiction (AHJ) which support Rail Activation and Final Safety Certification Requirements. The Contractor shall provide technical support to this effort.
 - 6) Contractor must request and gain approval from Sound Transit for track time or any other access through the Sound Transit Track Access Permit procedure during pre-revenue operations.
 - 7) Maintenance: Contractor must provide maintenance of systems elements for the duration of the pre-revenue operations phase. In the event of a component failure or general maintenance, coordinate with Sound Transit Operations prior to entering Pre-Revenue areas.

2.03 SYSTEMS INTEGRATION TESTING

A. SIT Overview

1. System Integration Testing (SIT) is the culmination of all subsidiary system testing to validate final operation of the integrated system completely (as a whole). Table A is a minimum set of required tests. In creation of the DIP and other integration information coming to light, the system integrator is responsible for defining any tests to de-risk SIT and add any SIT testing per project requirements to validate systems.
 2. The Contractor's integrated testing shall verify all elements on the rail system can function together properly as an integrated system. Details of the tests from previous Sound Transit projects are available upon request.
- B. SIT tests versus tests called out in Technical Specifications.
1. Testing
 - a. While several system integration tests are defined in individual system tech specs (e.g. 34 23 69) as shown in column "Test Definition" in Table A, this alignment is in terms of scope and criteria. Tests in lower-level technical specifications may be iterated until the integrator has a high level of confidence that the test passes. At this time, the owner will be requested to witness the SIT as a final validation of successful system integration. An example of this would be iterative live wire testing per 34 23 69 3.05 C until confidence in passing test results is gained. At this time, SIT 301 may be conducted.
 2. Submittal Clarification
 - a. Where scope of test is aligned between the subsidiary system testing technical specifications and a SIT per 01 91 13, the same document (test procedure, results and/or reports) may be used to satisfy both requirements if they meet all requirements of both specifications. In this case, the document must be submitted to both the tech spec and 01 91 13.
 3. Technical Specification Specific Plans vs System Integration Plan
 - a. Any test plans that are required by technical specifications for system integration are to follow the detail required per each specification. The System integration plan, provided by the contractor, that is an overview which covers all the requirements in section 3.04. Utilization of the SITP is intended for development of discipline specific tests that are required by technical specifications.
- C. Prerequisite testing guidance. This is a min set of requirements that will be discussed during subcommittee and tiger team meetings to get approval of test acceptance from ST. Prerequisites shall identify all steps, including those from lower level tests, must be completed successfully prior to any integrated tests.
1. Refer to Attachment 2 below.

2.04 ALIGNMENT OF T&C (TESTING AND COMMISSIONING) AND SIT (SYSTEMS INTEGRATION TESTING):

- A. Testing and Commissioning and System Integration Testing are two separate requirements. Both requirements are to be completed prior to handoff to Sound Transit.

- B. Tests that are performed during the Level 3 SIT may also require prerequisites in Level 1 or 2 commissioning which if so, will cause additional coordination between the two groups (e.g. operations and subject matter experts). Any identified issues during SIT may require re-commissioning of any lower-level elements.
- C. Tests that cover both a commissioning test as well as an integration test should be submitted in both sections.

2.05 ROLES AND RESPONSIBILITIES: CONTRACTOR AND AGENCY

A. Contractor Responsibilities:

1. The Contractor shall perform all the tests defined in the Testing and Commissioning Plan.
2. The Contractor shall ensure that a fully traceable and auditable record of all testing completed is maintained for the duration of this Contract. The Contractor shall utilize the Sound Transit provided Commissioning Database for maintaining current versions of all Test Procedures, Test Reports and Issues Log on Sound Transit's SharePoint Site. The Commissioning Database will reflect the current status of all Test Procedures, Test Reports and Issues in accordance with the requirements of this specification.
3. The Contractor is responsible for correcting any non-compliant items or defects found during testing including those found by Sound Transit personnel or other AHJs.
4. The Contractor is responsible for safely executing all testing and test support activities. The Agency reserves the right to order the cessation of any test or activity due to any safety concern, including personal injury and property damage, until the safety concern is resolved and eliminated.
5. The Contractor shall schedule and attend regular testing and commissioning meetings with Sound Transit to discuss Testing and Commissioning. Items discussed shall be documented by the Testing and Commissioning Manager and agreed upon by Sound Transit's Resident Engineer or delegate with due dates for assigned action items. Minutes shall be distributed to all attendees and other interested parties.
 - a. Testing and Commissioning Meetings shall include at a minimum the topics of:
 - 1) Testing and Commissioning schedule and progress, including a three-week look ahead schedule.
 - 2) Testing and Commissioning Issue Report Database open items.
 - 3) Test Plans, Procedures, and Test Results.
 - 4) Alignment with Sound Transit Systems Integration Test Plan
 - 5) Work Permit and Sound Transit EIC and resource requirements.
 - 6) LRV and LRV Operator needs.

- 7) Upcoming Test Readiness Reviews and Test Briefings
- 8) Any information, testing parameters, equipment set points that changed as a result of testing and shall be updated in the O&M Manuals.

b. Meeting frequency:

- 1) Prior to the beginning of Testing and Commissioning Test activities, conduct testing and commissioning meetings at least monthly, to review the Commissioning Database, plan, schedule, coordinate, and set test procedures. After the Testing and Commissioning Manager is approved, the first meeting shall be held 90 days prior to submission of the Testing and Commissioning Plan.
- 2) Following the approval of Testing and Commissioning Plan the Contractor should have monthly meetings. At three weeks prior to the beginning of Component or Equipment Testing the contractor shall transition into weekly meetings. On occasion, more frequent meetings may be required.
- 3) The Resident Engineer may require additional testing and commissioning meetings if the testing and commissioning process is behind schedule or if there are coordination problems. The Testing and Commissioning Manager may also request in writing additional meetings. Attendance at additional testing and commissioning meetings shall be at no cost to Sound Transit.

6. Contractor to provide expectations on ST staffing support (signal, train operators, safety oversight) so that ST can reasonably accommodate personnel as listed in section 2.03 c.1. At a minimum, contractor shall provide hours of staffing support required and what work activities are being scheduled.

B. Sound Transit Responsibilities

1. All personnel, facilities, rolling stock, equipment, and other resources, if agreed by Sound Transit to be supplied for use by the Contractor, shall be in accordance with Sound Transit's-accepted Testing and Commissioning Plan. The quantities, schedule, and other logistical aspects of Sound Transit making such resources available shall be in accordance with Sound Transit's-accepted Testing and Commissioning Plan, Cutover Plan, Site-Specific Work Plan (SSWP), System Access/Track Allocation Request, and Master Project Schedule (MPS). Access procedures to these resources shall be as pre-arranged with Sound Transit. The Contractor shall return all Sound Transit-provided items to Sound Transit in a revenue ready condition to the satisfaction of Sound Transit (which includes punch list completions and acceptance of deviations by Sound Transit).
2. Sound Transit reserves the right to deny access to any Sound Transit operational infrastructure or resources if the Contractor cannot demonstrate readiness of hardware, software, and Contractor resources or if preceding build, integration, and testing steps are not sufficiently complete and passed, at the sole discretion of Sound Transit.

3. Sound Transit will provide a Commissioning Database. Commissioning Database will be hosted on Sound Transit's SharePoint Site.
4. Sound Transit will provide the project System Integration Test Project Plan (SITPP) which shall be supported by the Contractor's System Integration Test Plan (SITP), as well as test procedures (see Attachment 1).
5. Sound Transit has the right to cease any testing/commissioning activities that may jeopardize revenue service or safety. Any confirmed or potential delays to revenue service due to systems commissioning must be reported to ST Operations / Link Control Center immediately.

C. Sound Transit Personnel

1. Sound Transit will provide signal maintainers, train operators, safety monitors, rail car maintainers and supervisors, LCC personnel, on-rail vehicle drivers, SCADA technicians, and access to Sound Transit system, as agreed in the accepted Testing and Commissioning Plan and Master Project Schedule. This is dependent on the contractor following the KCM track access process for coordination.
2. Sound Transit will provide Operations Representatives and Test Engineers to Witness all testing at its discretion as indicated in section 3.03 below.

2.06 MANAGEMENT OF TESTING AND COMMISSIONING

A. Testing and Commissioning Manager

1. The Testing and Commissioning Manager is responsible for the development and execution of all Testing and Commissioning activities and shall execute the testing and commissioning program in accordance with the approved Testing and Commissioning Plan and Testing and Commissioning Master Schedule. The Testing and Commissioning Manager shall manage and coordinate the Testing and Commissioning work and shall be supported by the System Integration Test Manager and specific System Test Engineers. The Testing and Commissioning Manager shall:
 - a. Coordinate with Subcontractors with respect to their responsibilities and contractual obligations for Testing and Commissioning.
 - b. Coordinate with System discipline testing managers to ensure timely development of System Test Procedures, Execution of Systems Integrated Tests and delivery of in-process and final Test Reports as outlined in the requirements of this specification
 - c. Obtain, assemble, and submit Testing and Commissioning documentation.
 - d. Conduct on-site Testing and Commissioning meeting, with remote participation capabilities.
 - e. Develop and maintain the Testing and Commissioning schedule. Integrate Testing and Commissioning schedule into the construction schedule. Update schedule and submit monthly along with the monthly Baseline Project Schedule update.
 - f. Populate and maintain the Testing and Commissioning Database per section 2.05.

- g. Prepare, with assistance from Subcontractors as needed, and submit the Testing and Commissioning Activity Procedures and test forms.
- h. Verify that Testing and Commissioning Activities have been completed with passing results.
- i. Ensure that necessary test instrumentation is available during Testing and Commissioning Activities and that those instruments meet quality and calibration requirements and are in good working order.
- j. Track and report Testing and Commissioning issues until resolution and retesting is successfully completed.
- k. Retain original records of all Testing and Commissioning Activities, organized as required for the Testing and Commissioning report. Provide Sound Transit's Representative access to these records upon request throughout the Contract period.
- l. Assemble and submit the Testing and Commissioning Report to Sound Transit for acceptance.
- m. Provide 24/7 contact and coverage information to ST for use by the Link Control Center in case of unplanned system failures

B. Systems Integration Test Manager/Integrated Test Lead

- 1. The Systems Integration Test Manager/Integrated Test Lead shall be responsible for directing the performance of all Systems Integrated Testing that involves a Passenger Vehicle and a related System element such as Communications, Supervisory Control and Data Acquisition (SCADA), Building Management Systems, Fire Detection and the Emergency Ventilation System (EVS), Signaling and Traction Electrification as defined in the Testing and Commissioning Plan. The System Integration Test Manager/Integrated Test Lead shall be responsible for all aspects of the System Integrated Test effort, including coordinating access to test locations, arranging support personnel from other Contractor functional areas and from areas not under the Contractor's authority, coordinating test efforts with other functional area construction and test activity, and providing overall monitoring of the System Integrated Test Performance. The System Integration Test Manager/Integrated Test Lead shall:
 - a. Manage the development of the Systems Integration Testing procedures.
 - b. Report to the Testing and Commissioning Manager and provide support with the timely scheduling and execution of all System Integrated Tests as identified in the Testing and Commissioning Plan.
 - c. Plan, schedule and execute each System Integration Test.
 - d. Ensure that all pre-requisite tests have been performed prior to the performance of each Systems Integration Test.

C. System Test Engineer

- 1. The System Test Engineer is the lead engineer responsible for performance of the system testing and integrated tests for an individual system;

Communications, Supervisory Control and Data Acquisition (SCADA), Building Management Systems, Fire Detection, Fare Collection, Signaling, Traction Electrification, Passenger Vehicles or any other specialty system that requires a technical expert to perform the integrated testing and commissioning. The System Test Engineer shall provide support to the System Integration Test Manager and the Testing and Commissioning Manager as required. The System Test Engineer shall:

- a. Lead the development of the individual system test procedures and test reports.
- b. Be responsible for the execution of individual System testing and commissioning.
- c. Support the Testing and Commissioning Manager and the Systems Integrated Test Manager in development of the Testing and Commissioning Program Plan and Testing and Commissioning Master Schedule.

2.07 TESTING AND COMMISSIONING MASTER SCHEDULE

A. The Testing and Commissioning Master Schedule: Develop CPM schedule with tests to identify how the Systems Integration Testing process will meet overall Contract schedule durations. Identify critical path tests. Activities shall be linked to the Baseline Project Schedule such that changes in predecessor activities are reflected in the Testing and Commissioning Master Schedule.

1. Schedule shall include a line item for each Commissioning Test or activity specific to the equipment or Systems involved.
2. Identify CPM schedule predecessor activities and dependent activities for Testing and Commissioning work.
3. Identify Testing and Commissioning work predecessor activities, prerequisites and dependencies in monthly statused CPM schedule Submittals.
4. Identify Testing and Commissioning work activities in monthly CPM schedule update Submittals.
5. Identify track access permit application activity.
6. Identify Testing and Commissioning work predecessor activities, prerequisites and dependencies in three- week look-ahead schedule Submittals.
7. Integrate Testing and Commissioning work into the Contractor's construction schedule and updates, and the Three-Week Look-ahead Schedules.

B. Three Week Look Ahead Schedules:

Three-week look-ahead schedules shall identify the following for each Testing and Commissioning Activity for the following 3 weeks:

1. Activity date
2. Activity start time and anticipated duration

Three-week look-ahead schedules will be used to notify and coordinate participation of Sound Transit's Witnesses, support equipment, and EIC. The Contractor shall

provide the following information for each Testing and Commissioning Activity to the Resident Engineer at the Weekly Construction Meeting:

3. Staging location for participants and witnesses to meet
4. Contractor and Sound Transit personnel that will be required
5. Sequencing
 - a. For any particular assembly, system or area of work, Testing and Commissioning Activities shall proceed in the following order:
 - 1) Complete testing at the lower number level prior to starting the next higher number level, except that Level 1 component tests shall be performed prior to Level 1 Start-up if the proper function of the component impacts the performance of the Start-up.
 - 2) Verify the functional readiness of equipment and system.
 - 3) Notify the Resident Engineer if acceptable results cannot be achieved due to conditions beyond the Contractor's control or responsibility.
 - 4) Tests shall not be performed and test reports and results will not be considered valid until procedures are approved by Resident Engineer.
 - 5) Tests results showing prerequisite test passed must be submitted before subsequent tests can be performed as outlined in accepted Testing and Commissioning Plan.

PART 3 - EXECUTION

3.01 TESTING AND COMMISSIONING PLAN

- A. The Contractor shall develop and submit a complete overall Testing and Commissioning Plan to Sound Transit for review and acceptance. Contractor shall utilize the Sound Transit General Testing and Commissioning Plan as the basis for the development of the Contractor's Testing and Commissioning Plan. Submit the Testing and Commissioning Plan no later than 180 days prior to the start of the first scheduled Testing and Commissioning Test.
- B. The Contractor shall implement the testing, commissioning and reporting process in accordance with the Testing and Commissioning Plan. In addition, the Contractor shall develop and submit a Cutover Plan for each cutover phase of the project, to provide further elaboration and updates based on the overall Testing and Commissioning Plan. Each Cutover Phase-specific Testing and Commissioning Plan shall include all details specific to the cutover area needed to plan and execute the cutover phase, including but not limited to over-and-back procedures and the final cutover methods in support of revenue service.
- C. The Testing and Commissioning program shall be requirements-based to demonstrate that all requirements are met by the System at each level of testing. The Contractor shall define and provide at minimum the testing levels defined in section 2.02. The Testing and Commissioning program shall be multi-leveled, structured from factory to

field, and progressed through increasing levels of complexity from component/subsystem to system-level testing. The Testing and Commissioning plan shall describe the approach to the component/subsystem and system-level testing and how it relates to the deployment and migration of each System.

- D. The Testing and Commissioning Plan shall provide details, for each major system and subsystem (the detailed list of which shall be developed by the Contractor), how the requirements of the Technical Specifications will be achieved, including, at a minimum, the following:
1. Introductory overview and scope of the Testing and Commissioning work, developed specifically for the Contract.
 2. A clear and logical testing and commissioning sequence for the entire program, including dependencies between predecessor and successor tests and other activities. This shall be incorporated into and maintained in the Master Project Schedule.
 3. Preliminary Testing and Commissioning schedule that summarizes execution of activities by specification section, testing and commissioning level and its relationship within the contract.
 4. Descriptions and listings of what testing and commissioning activities will be done.
 5. Responsibility, accountability and authority of the Contractor and the Sound Transit personnel
 6. Review and utilization of the Final Design Verification Report.
 7. Methods of compliance to Sound Transit KCM Track Access Permitting.
 8. Record-keeping assignments, procedures, and forms
 9. Methodology for tracking and correcting failures and unexpected observations including the use of the Issues Log as defined in section 3.09.
 10. Specific information on means and methods for testing each cutover phase and each distinct cutover area.
 11. An outline of the organization of Testing and Commissioning team members, their defined roles, their company and its relation to the project, their names, contact information and position or title.
 - a. Descriptions of the roles and responsibilities for testing and commissioning team members to differentiate portions of the Testing and Commissioning work with which the team members are involved. Define in detail the responsibilities and specific tasks to be completed by the individual members including, but not limited to, test procedure development, approval and execution; database management; coordination of meetings, communication and notifications.
 - b. Describe intended methods for Communication within the team, including meeting organization, routine status updates, three-week look ahead schedules and management of the database.

12. Matrix of Testing and Commissioning Activities, organized by specification section to identify Testing and Commissioning Activities by subject area, equipment or system, the estimated execution dates, pre-requisites, predecessors, and the primary party responsible for performing activities and providing necessary instrumentation.
13. Achieve a mutual understanding between Contractor and Resident Engineer on range, scope, and other aspects of tests to be conducted.

3.02 SYSTEMS INTEGRATION TEST PLAN (SITP)

- A. The Contractor shall develop and submit an overall Systems Integration Test Plan (SITP) to Sound Transit for review and acceptance.
- B. System Integration tests are functional tests performed when all systems that need to talk to each other come together. These System Integration Tests provide verification of the integrated systems required to operate a railroad and provide a key element of validation of the System as a whole. Separate subcontractors may provide individual systems, but Contractor has the responsibility to test functionality of Systems when they are interconnected. These tests also include integration testing between Sound Transit equipment and new equipment provided by the Contractor.
- C. Tests involving other contractors such as fare collection equipment, radio and civil contractors must be coordinated with other contractors.
- D. Review and utilization of Final Design Verification Report along with Testing and Commissioning Plan.
- E. At a minimum, the System Integration Test Plan shall provide the following, including:
 1. Organizational Structure.
 2. Criteria and plan to meet safety certification testing requirements.
 3. Plan for integration test procedures, System Tests list scheduling, support, conduction and documenting the integration tests.
 4. Describe Contractor responsibilities for testing from factory testing through Integrated Testing and up to pre-revenue testing.
 5. Plan for coordination between, all interfacing contracts and Sound Transit Operations.
 6. Access control to Project area and plan to manage the access regulations between contractors, testing, and rail operations. For access to revenue service areas of mainline track adhere to track access procedure outlined in the Contract Documents.
 7. Integrated Testing Elements:
 - a. List test personnel, their responsibilities, and resources necessary for integration.
 - b. Interface with Sound Transit: List tests required to integrate Systems elements with existing Sound Transit systems.
 - c. Integrated Test Sequence: List tests that must be performed first to obtain data for interface with subsequent designs.

- d. Integrated Test Schedule: Develop CPM schedule with tests to identify how design integration process will meet overall Contract schedule durations. Identify critical path tests.
 - e. List and describe tests.
 - f. For each test provide a test procedure and test results.
- 8. Support and Coordination:
 - a. Notify Resident Engineer, at least 2 weeks in advance, of any scheduled integrated test.
 - b. Resident Engineer or designated representative may witness each test.
 - c. Sound Transit will be responsible for LRV operations functions during integrated testing. Sound Transit will arrange operations support for integrated testing as requested by Contractor.
- 9. Meetings:
 - a. Hold weekly integrated test status meetings with Resident Engineer during integrated testing period.
 - b. Meeting Attendees: Project Manager, Integration Test Lead, Test Directors involved in that week's testing activities, and Resident Engineer.
 - c. Agenda: Progress, status issues, and future activities. Review monthly testing summary.
 - d. Document these meetings with meeting minutes and provide an initial distribution to attendees within 1 week for comment.
 - e. Incorporate any Sound Transit and Resident Engineer comments on meeting minutes and provide final copies of minutes at next meeting.
- 10. Integrated Test Responsibilities:
 - a. Identify Integrated Test Lead position who is responsible for managing day-to-day activities for the SITP and each System Test Director. Test Lead and Directors must be present on-site during testing activities.
 - b. Integrated Test Lead is responsible for coordinating with Resident Engineer and Sound Transit, provides advance notice for testing dates, issues requests for Sound Transit support and track access for revenue operation sections of Sound Transit LRV System.
 - c. System Test Director: Manages execution of each test procedure, arranges, in conjunction Integrated Test Lead, support personnel for each test.
- 11. Staffing:
 - a. Coordinate staffing provided by others that may be required for integrated testing effort.

- b. Sound Transit Operations, Maintenance, Engineering, and Construction Management staff may witness actual execution of tests.
 - c. This process is intended to maximize involvement of Sound Transit employees to familiarize them with the Project Work to the greatest extent possible.
- 12. Cutover plans
- 13. Resource needs
- 14. Test schedules
- 15. Test sequencing
- 16. Safety measures – e.g. protected crossings, job hazard analysis, site specific safety info, communications (Irv before radio commissioned), etc.
- 17. Prerequisite definition & tracking
- 18. Configuration control - changes happen post test
- 19. Iterate / revisit plan periodically
- 20. Integration of individual test plans

3.03 TESTING PROCEDURES

- A. For each individual test to be performed throughout the Contract period, including all Proof of Concept, Factory, and Field testing specified herein, the Contractor shall submit Test Procedures for Sound Transit's acceptance.
 - 1. The Contractor test procedures shall list clear unambiguous criteria for each step indicating what would be a result in a PASS, FAIL or INCOMPLETE result.
 - 2. A test fails if the expected results for it are not achieved as described in the criteria.
 - 3. Only if all test steps of the procedure have passed, shall the test be recorded as passed.
 - 4. If any test step is not performed, the procedure shall be marked as incomplete. Any problem, failure or procedure mark-up arising from the tests shall be reported and recorded.
- B. The test procedures shall contain, at a minimum, the following:
 - 1. Test ID as identified in the Testing and Commissioning Plan and approved by Sound Transit;
 - 2. Test objective with the name of the feature and/or function to be tested;
 - 3. Revision level and reference number of the test procedure;
 - 4. References to the functional, design, user, and any other documents describing the function;

5. List and detailed configuration descriptions of all subsystems and components under test
6. Test location
7. Estimated time
8. Expected results for each test step with success/failure criteria in quantitative terms
9. Safety flags to identify and verify key items to ensure safe system behavior in the scope of the test
10. Safety issues and concerns to be addressed/mitigated
11. Clearly identify required outages, schedule impacts, and recovery methods
12. Sequence of testing including prerequisite tests
13. Equipment and instrumentation required
14. Weather and other ambient conditions during the test
15. Test setup and initial conditions
16. Testing pre-requisites
17. Descriptions of the techniques and scenarios to be used to simulate system field inputs and controlled equipment
18. Sound Transit support requirements, including personnel, equipment and trains/work vehicles, Link Control Center accommodations
19. Step-by-step descriptions of each test step, including train movements and the inputs and user actions for each test step
20. Data to be recorded and evaluation procedure
21. Space to be provided in the test procedure and filled in during the performance of the test for the software to be used, with revision numbers identified
22. Reference to Testing and Commissioning Issues Report generated as necessary
23. Type of report or data to be issued
24. Test personnel performing the test, Attendees and witnesses who shall sign test procedure witness sheets
25. A test data sheet form to capture the items to be recorded at during the test
26. Test Procedures shall be inclusive and thoroughly test each subsystem and component, both independently and collectively as an integrated system, for Sound Transit's acceptance.

- C. Test Procedures shall consist of pre-printed step-by-step procedure sheets for each test, with any salient data or reference material incorporated, attached or referenced.

When completed by the test personnel and checked for accuracy and completeness, the sheet shall be submitted as the test report.

1. The test sheets shall contain a check-off system for each test, and a blank space adjacent to the expected range of values in which to record the test readings.
 2. When tests require specific meter or test instrument readings, the pre-printed data sheet shall show the allowable range of values for each step of the test. Data sheets shall also include test equipment information, including manufacturer, model number, serial number and calibration information.
- D. During field testing, if any temporary changes in software or hardware are made for any reason, it shall be identified and captured in the Contractor's configuration management system. All changes shall be removed after the completion of the test, with the software and hardware under test returned to original configuration, pending formal build, acceptance, and release of any desired changes resulting from the test.
- E. During testing, simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Provide equipment to simulate loads. Set simulated conditions in accordance with approved Commissioning Test Procedures, as directed by the Commissioning Coordinator. Document simulated conditions and methods of simulation. After tests, remove external loads and return settings to normal operating conditions.
- F. Test Procedures shall be submitted 60 Days prior to commencement of each test and shall be approved prior to 30 days prior to the start of any testing. The contractor shall provide any necessary revisions prior to approval from ST.

3.04 MONTHLY TEST SUMMARY

- A. Show consolidated test data including tables, curves, photographs, and any additional test data required to support test results. List summary and conclusions based on test data for each system.
- B. List tests performed, when and where the test is performed, and the test results (passed or failed). List tests scheduled for the upcoming month including personnel, equipment, and other resources required to complete the tests. List any issues impacting scheduling of tests. Provide update to the testing CPM schedule and list critical path tests.
- C. Provide an update of the Test Issue Log to show new issues found and issues with resolutions determined and retests passed.

3.05 TEST READINESS REVIEWS AND TEST BRIEFINGS

- A. The Contractor shall conduct a Test Readiness Review (TRR) at least five days prior to any type of test. The Test Readiness Review will be attended in person or via web meeting by Sound Transit and any third parties required for the test. The Contractor shall demonstrate through the Test Readiness Review that the system safety, logistical, and other necessary elements for test are ready. The Contractor shall ensure that all safety issues and hazards are identified, reviewed, and completely mitigated. The Contractor shall also be responsible to obtain all applicable work and track access permits from Sound Transit. As a prerequisite to the TRR, the Contractor shall demonstrate approval of the procedure for the subject test and closure of all design review action items for the subject under test and its subassemblies. At the TRR, the contractor shall review open nonconformance and issue reports generated during previous testing of the test subject and its subassemblies (i.e. lower level testing).

- B. At the time of every test, upon the start of every work shift and whenever there are changing conditions, personnel, or activities, the Contractor shall conduct a safety briefing with all test personnel involved. The safety briefing shall review and establish the work to be performed, physical and other limits of the work, emergency procedures, potential hazards and mitigation, address any safety concerns of any personnel, and other topics needed to ensure safe conduct of the test. In the safety briefing, the methods and protocols for communication among personnel shall be established, to ensure safe train movements and otherwise ensure safety during the testing activities.

3.06 WITNESSING OF TESTS

- A. Sound Transit will provide operations representative and test engineers or inspectors to witness and verify testing performed by the Contractor. Sound Transit will advise the Contractor if Sound Transit will be witnessing the test(s) within five days of receipt of the Test Notification. The Contractor shall accommodate such test witnessing.
- B. If Sound Transit does not confirm the witnessing, Sound Transit shall still have the right to witness any and all tests. In this circumstance the Contractor shall not be required to make any arrangements to enable such witnessing.
- C. As part of test witnessing by Sound Transit representatives, the Contractor shall provide informal training opportunities for system familiarization, with the test articles and test environments of any witnessed test. Witnessing of tests shall not be considered as acceptance of test results or test reports.

3.07 TEST REPORTS

- A. The Contractor shall ensure that test results compiled in a test report provide an accurate record of the event detailing version(s) of software, subsystem(s) and test tools. Any supporting evidence such as drawings, tools, data and log files must be included as part of the test report.
- B. The Contractor shall ensure that the original test results and supporting evidence will be archived and available for audit by Sound Transit.
- C. Upon completion of each type of test described in this section, the Contractor shall submit to Sound Transit for review and acceptance a Test Report. Test Reports shall include the completed test procedure form plus all the following information if not already included:
 - 1. Pass or Fail results overall and for each test step
 - 2. Reference to the appropriate section of the test procedures
 - 3. Description of the test performed
 - 4. Date of the test
 - 5. Description of all problems encountered and applicable defect identification numbers
 - 6. Any deviations to the test procedure along with descriptions and rationale for any observations or deviations from the test procedure
 - 7. Test results
 - 8. Identification by signature of the Contractor's test engineer, and of Sound Transit's personnel or representatives present (if any)

9. Provision for comments by Sound Transit representatives
10. Names of any log files used to verify results
11. Retest procedures, if required
12. Software/Hardware version numbers
13. Final configuration of all tested equipment including set-points developed or modified during testing and commissioning.
14. Upon completion of each test, the Contractor shall update and submit the following:
 - a. Configuration item list
 - b. Technical Change Reports.

3.08 TESTING AND COMMISSIONING ISSUES

- A. Testing and Commissioning activity results that are not within the range of acceptable results are Testing and Commissioning Issues.
- B. Resolve Testing and Commissioning Issues promptly. Testing and Commissioning Issues where the issue is obvious and resolution can be completed in a time agreed to by Sound Transit shall be noted on the Testing and Commissioning test data form and a Testing and Commissioning issue report shall be issued. A new Testing and Commissioning test data form, marked "retest," shall be initiated after the resolution has been completed.
- C. Test Issue Log: Contractor to maintain this document, on ST database, to track test and commissioning issues and their corresponding resolution. Provide a summary sheet tracking systematic test issues to aid in identification of quality and procedural problems.
 1. For each test issue, provide the following information on the Test Issue Log:
 - a. Test number and description.
 - b. Equipment identification and location.
 - c. Briefly describe observations about the performance which was associated with failure to achieve acceptable results. Identify the cause of failure if such is apparent.
 - d. Diagnostic procedure or plan to determine the cause if the cause is not readily apparent.
 - e. Diagnosis of fundamental cause of issues as specified below if the cause is not readily apparent.
 2. For each test issue resolution provide the following information on the Test Issue Log:
 - a. Identify the fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
 - b. Identify corrective action taken to resolve the issue.

- c. List date of retest and result. Final entry shall be of test that passed.
- D. Track and report test issues until resolution and retesting are successfully completed. Maintain a current record of testing issues on a Test Issues Log to be submitted with the Monthly Testing Summary.
- E. Complete a Testing and Commissioning Issue Report for Level 3 & 4 Testing and Commissioning Activities for which acceptable results were not achieved. All Issues Reports shall be logged into the Commissioning Database Issues Log.
- F. Contractor shall record the following when Testing and Commissioning Issues are identified:
 - 1. A unique, sequential number for tracking purposes for individual Testing and Commissioning issue reports when they are created.
 - 2. Action distribution list
 - 3. Report date
 - 4. Amended test number and description
 - 5. Equipment identification and location
 - 6. A brief description of observations concerning the performance, which was associated with failure to achieve acceptable results. Identify the cause of failure if such is apparent.
 - 7. Diagnostic procedure or plan to determine the cause if the cause is not readily apparent
 - 8. Diagnosis of fundamental cause of issues as specified below if the cause is not readily apparent
- G. A Testing and Commissioning Issue Report shall be logged in the Issues log of the Commissioning Database within 24 hours of the time the issue is identified.
- H. Complete the closure of the logged Issue when the issue has been resolved. Include:
 - 1. The fundamental cause of unacceptable performance as determined by diagnostic tests and activities
 - 2. The corrective action taken to resolve the issue, and the dates and initials of the persons making the entries
 - 3. The schedule for retesting
 - 4. Signature and date of the person(s) who performed actions
- I. The Testing and Commissioning Issue Report shall be updated and logged into the Issues Log of the Commissioning Database within 24 hours of the time the issue is reported resolved.
- J. Track and report Testing and Commissioning issues until resolution and retesting are successfully completed. Maintain a current record of Testing and Commissioning issues on Testing and Commissioning Issues Log on the shared Commissioning Database.

- K. Do not report multiple issues on the same Commissioning issue report, except if an entire class of devices is determined to exhibit the identical issue. In that case the identical issue for the entire class may be reported on a single Commissioning issue report. If a single Commissioning issue report is used for multiple devices, each device shall be identified in the report and the total number of devices at issue shall be identified.
- L. The Quality Manager plays a key role in the testing and commissioning process. Per 01 45 00 Quality Management Specification, the quality manager should ensure all procedures and reports are being submitted correctly per standards. The quality manager shall coordinate issues from the construction issue's log that require any further testing/retesting are making its way to the SIT and commissioning issues log and that they are being completed per schedule. The quality manager shall ensure any hold point checklists that are completed have the relevant forms and signatures for signoff from commissioning or SIT. They shall not conduct any commissioning or SIT tests and IDR's that falls under the responsibility of the System Test Engineer.

3.09 CATEGORIES OF TEST FAILURES

- A. Test failures and defects shall be categorized by the Contractor based on standardized severity levels; the categorization is subject to Sound Transit acceptance and in case of disagreement, revision at the sole discretion of Sound Transit. Categories shall be numbered 1 through 4 as defined below:
 - 1. Critical: Safety or operationally catastrophic or critical
 - 2. Severe: Prevents or severely limits proper operation of the system, subsystems and components under test
 - 3. Significant: Requirement(s) in the accepted test plan have not been met
 - 4. Minor: Test failure due to a relatively minor behavior or appearance, which can be reasonably worked around temporarily until the defect is corrected.
- B. Category 1 and 2 failure actions: Further deployment, migration, and testing shall not be allowed of items with open Category 1 and 2 failures against the hardware or software item allocated the failure, except that informal site engineering testing is allowed provided that the testing can be done safely and productively.
 - 1. If a Category 1 or 2 Failure is identified during field testing, no equipment related to the specific problem may be placed into service without a resolution.
 - 2. Depending on the severity of the problem either testing will immediately stop and the Contractor shall evaluate and correct the problem before testing is resumed, or other testing will continue and the problem will be evaluated and corrected at a mutually agreed upon time.
- C. Category 3 and 4 failure actions: Further deployment, migration, and testing may be allowed of items with open Category 3 and 4 failures, at Sound Transit's sole discretion, provided that the Contractor presents and implements a reasonable work-around plan to allow the productive continuation of deployment, migration, and testing activities.
- D. Category 1 or 2 Factory Tests: If a Category 1 or 2 failure is identified during the factory testing, no equipment related to the specific problem can be shipped to the field.
- E. Category 3 or 4 Factory Tests: If a Category 3 or 4 failure is identified during the factory testing, a plan of action for resolution of the failure must be agreed between the

Contractor and Sound Transit officials before the equipment is installed. Shipping documentation shall reflect test failure and requirements for additional work.

- F. No equipment shall be energized or placed in operating mode until completion of the Field Installation testing and permission of the Resident Engineer.

3.10 REPAIR / RESTORATION

- A. Diagnosis of Cause: Where the fundamental cause of a Testing and Commissioning issue is not readily apparent, the Contractor shall perform, diagnostic tests and activities required to determine the fundamental cause of the issues being observed.
 - 1. If it is determined that the issue results from design errors or omissions or other conditions beyond the Contractor's responsibility the Contractor is to document the issue and notify Sound Transit of the probable cause of the issue.
- B. Records shall be kept for each step of the diagnostic procedure prior to performing the procedure. The written procedure shall be updated as changes become necessary.
- C. The results of each step of the diagnostic procedure shall be recorded in the testing log.
 - 1. Record the conclusion of the diagnostic procedure with regard to the fundamental cause of the issue.
 - 2. Determine and record corrective measures including repair and restoration.
- D. Include diagnosis of fundamental cause of issues and the repair or restoration activities in Testing and Commissioning Issue Report Log Part 2 and include in the Testing and Commissioning Issues Report.

3.11 TOOLS AND TEST EQUIPMENT

- A. The Contractor shall develop and use software, laptops, and other test tools and devices to ensure that the requirements of the testing and commissioning phase are met. Test tools are subject to validation tests before use in their intended environment and prior to the formal testing.
- B. The Contractor shall ensure that all industry standard test equipment and instrumentation has been validated and/or calibrated against known and traceable requirements and that valid calibration certificates are available for inspection.
- C. Provide a list of instruments and test equipment that will be used in the Testing and Commissioning Tests. Sort instruments and test equipment according to intended use. Obtain acceptance of the test equipment identification list prior to executing Testing and Commissioning Tests. Instruments and test equipment not included in the accepted test equipment identification list shall not be used. The test equipment identification list shall include:
 - 1. Test equipment identification number: Identify equipment by a unique alphanumeric identifier to be referenced in submitted procedures.
 - 2. Range
 - 3. Accuracy
 - 4. Resolution

5. Intended use

D. Proprietary test instruments and tools:

Test instruments and tools are proprietary if they are required by the equipment manufacturer for testing, calibrating, servicing or maintaining equipment provided under this Contract, and if the test instruments or tools are available exclusively through said manufacturer or their authorized representative.

1. The Contractor shall provide proprietary test instruments or tools required by the equipment manufacturer and shall operate the proprietary test instruments or tools as required for Testing and Commissioning work.
2. Identify proprietary test instruments or tools required in the test equipment identification list. Include a separate list of proprietary test instruments in the Operations and Maintenance manuals.
3. Proprietary test instruments or tools become the property of Sound Transit upon completion of Testing and Commissioning the Work.

END OF SECTION

ATTACHMENTS

Attachment 1: Sample Integrated Text Matrix

Attachment 2: Sample SIT Prerequisites

ATTACHMENT 1 – SAMPLE INTEGRATED TEST MATRIX

Test ID	Test Description	Test Objective	Test Definition (Verify tech spec references per project)
101	Radio Communications Device	Verify personnel are able to communicate by radio throughout the extension, stations and any wayside buildings.	27 60 07-009 1.04 D 3 Radio System Testing
102	Cart Clearance	Verify that there is adequate clearance between the LRV (including pantograph) and all equipment and facilities along the segment (including underbody clearances) as demonstrated by a clearance cart.	OCS clearance per 34 23 69 3.01 E.2 Overhead Contact System Testing; Car body clearance per DCM Chapter 4, 4.2.6.
103	LRV Car Mover Clearance	Verify that there is adequate clearance between the car mover and equipment and facilities along the segment.	Low speed sweep with car mover to be used for SIT 201.
201	LRV Dead Tow Clearance	Verify that there is adequate clearance between the LRV and the equipment and facilities along the extension.	Dead wire per 34 23 69 3.05 B Overhead Contact System Testing; Car body clearance per DCM Chapter 4, 4.2.6.
202	Track Switch / LRV Interface	To verify proper operation, orientation and wheel to rail interface of the switches using a light rail vehicle.	Operate a two car (minimum) LRV at walking, then operating speed over track switches in each direction inspecting track pre and post run, and noting interface during operation focusing on switch points and frogs.
203	Bumping Post / LRV Interface	To verify proper interface between LRV and bumping posts.	Bring LRV near to post to check alignment of bumping pads and anti-climbers. Verify pantograph stays on OCS up to post.
204	Ride Quality	Evaluate riding comfort of an “as-finished” train operating under anticipated revenue service conditions on “as-built” trackwork.	Evaluate using one or multiple cars at weight conditions defined by SME. Qualitative test could be followed by quantitative assessment if required.
301/302	Live Wire OCS (Including Camera)	Verify the LRV pantograph and OCS perform as designed with the system energized.	34 23 69 3.05 C Overhead Contact System Testing
303	TPSS Emergency Trip	Verify proper Transfer Trip, ETS, including all FCC ETS, and SSS operation.	34 21 16.11 3.02 D Traction Power Substation Testing

304	Overcurrent Relay / Pull-Away	Verify that the Traction Power with OCS system will allow multiple train starts under full load in the same power grid throughout the extension. i.e. verify "worst case" operating scenario from load flow analysis.	34 21 16.11 3.03 E Traction Power Substation Testing
305a	Rail / Earth / Isolation / Detection	To verify the Rail to Earth Voltage is within allowable limits and that the rail is properly isolated.	26 42 55 (Civil spec) Track Resistance Testing
305b	Rail to Ground Monitoring	To verify the Stray Current Monitoring System monitors voltage as designed and that the values are within limits. DURING PRE-REVENUE	34 21 16.11 3.03 D Traction Power Substation Testing
401	Train Control / Track Circuit Shunting	To verify that a single axle of one LRV provides sufficient shunting at ends of track circuits to permit detecting the vehicle and that the train signals and control operates as intended.	34 42 98 3.01 D 4 Signal System Testing - (SIT requires LRV for test)
402	Train to Wayside Comms (TWC)	Verify the proper operation of TWC equipment. Verify that the train is communicating with the system, all valid TWC codes are requested and decoded.	34 42 98 3.01 D 6 Signal System Testing - (SIT requires LRV for test)
403	Control Line / In Cab Signalling	Verify that a under all circumstances, the correct cab signal is received by the train as shown on the control lines.	34 42 98 3.01 D 2,3,5 Signal System Testing - (SIT requires LRV for test)
404	Train Tracking	Verify train control/signal system identifies multiple train movements on same and intersecting tracks throughout the Extension and that signal aspects in the field match the LCC screens.	Traverse alignment with LRV while monitoring TCS screens in LCC (or laptop proxy). Ensure multiple trains are accurately tracked and ensure that the signal aspects in the field match those on the screen.
405	Signal Aspect Sighting	Verify visibility of all signal aspects in the Extension.	34 42 98 3.01 D 2; Any signal sighting distance under 600' must be accepted by EOR.
406	Control Line Braking Distance	To verify that the designed braking distances provide adequate stopping distance for operational vehicles.	Identify and agree (w EOR) control lines for test, use degraded brake configuration for LRV ATP, travel at Control Line speed and go into safety braking at extreme of control line and measure stopping distance.
407	Wayside Sign / Marker Visibility	Verify visibility and ensure that all wayside signs and markers on the Link	34 42 98 3.01 D 2 Signal System Testing; evaluate sighting visibility of

		ROW are outside of the dynamic envelope of the LRV.	all signs and markers. E.g. speed signs, stopping markers, etc...
408	Traffic Signal Interface	To ensure the signal system properly spaces trains and traffic. Verification of all systems for traffic and pedestrian grade crossings including deployment and audio, visual and gates and all associated timings. Tests must be coordinated with AHJs as required.	34 42 98 3.01 D 7 Signal System Testing
501a	EFN Test (Emerg Fire Network)	Verify that the installed EFN operates in a normal, and failover configuration as intended. Testing includes transmission tests, link speed and ping tests, and traffic failover tests.	N/A
501b	TCN Test (Train Control Network)	Verify that the installed TCN operates in a normal, and failover configuration as intended. Testing includes transmission tests, link speed and ping tests, and traffic failover tests.	N/A
502	EVS Tunnel Airflow Test	Verify air flow and velocity within tunnel align to design and meet requirements for fire, life safety.	Interstation Tech Spec (Civil)
503	SCADA EVS Sequence	Verify proper integration between SCADA, field control programmable logic controllers, fan damper control panels, emergency ventilation control panels, fire alarm control panels and building management systems. End to end test verifying alarms picked up by EVS at the station are registered at LCC and vice-versa. Conduct sequence testing verifying the Emergency Response Matrix (tunnel stations).	Interstation Tech Spec (Civil)
504a	SCADA TCS Test (Signals); SCADA TCS Test (Traction Power)	Verify the monitor and control functionality of all signals and traction power operation on the TCS network operate as designed.	34 42 98 3.01 E 1; 34 21 16.11 3.03 C; 25.00.001.07F.3.a-f
504b	SCADA TCS Train Tracking with LRV Test	Verify train tracking, routing and monitoring are demonstrated using LRVs operating on the extension.	25.00.00.1.07F.3.g-l
504c	SCADA TCS Train Tracking Accuracy Test	Verification of the PACIS integration aligning platform announcements with train arrival information. (PIMS may replace this scope going forward)	25.00.00.1.07F.3.n

504d	TCS Performance Testing	Robustness measure of database used for TCS information DURING PRE-REVENUE	25.00.00.1.07F.3.o-p
505	SCADA BMS Test	Conducted from the SCADA BMS user interface at LCC and verifies proper control and indications of all BMS devices in the field.	Verify the monitor and control function of all BMS points from the LCC.
506	PA/VMS/VES & ERM Verification	Verify the integration of all audio and visual station messaging elements from standard operation through emergency scenarios. the Voice Evacuation System and the Station Control Unit and Station PA subsystems.	Verify the operation of the PA, VMS and VES through integration of the EVCP, FACP and SCU in all modes from normal operating to alarm, including modes in the ERM. Verify message priority for different messaging systems.

ATTACHMENT 2 – SAMPLE SIT Prerequisites

Test ID	Test Description	Civil Prerequisite	System Prerequisite
S1-101	Radio Communications Device	Complete building enclosures	Complete Installation of Radio Network
S1-102	Cart Clearance	- Final Track Survey Approved - Track weld reports received - All wayside equipment with chance to affect Dynamic envelope installed.	All wayside equipment installed
S1-103	LRV Car Mover Clearance	- Final Track Survey Approved w/ Track Gage measurements - Fire Department training of lifting plan	SIT 102 Clearance Cart Test report Approved
S1-201	LRV Dead Tow Clearance	- Final Track Survey Approved w/ Track Gage measurements - Fire Department training of lifting plan	SIT 102 Clearance Cart Test report Approved
S1-202	Track Switch / LRV Interface	Level 1&2 track switch commissioning tests Approved	Signals / interlocking Level 2 testing Approved
S1-203	Bumping Post / LRV Interface	Bumping posts installed	OCS installed over bumping post
S1-204	Ride Quality	Rail grinding/polishing complete	SIT 201 LRV Dead Tow Clearance Approved
S1-301/302	Live Wire OCS (Including Camera)	- Demonstrate that TPSS have completed and passed FIT - Civil R2G testing approved - Working limits and speed limits for train (overall work plan) - Communication plan (if SIT 101 is not completed) - TCP approved. - Fire Department Authorized and Trained - Any vegetation overgrown considered that could impact testing	- SIT 201 LRV Dead Tow Clearance Approved - TPSS L2 testing - Systems Certificate of Conformance 4 car consist available
S1-303	TPSS Emergency Trip	Demonstrate that TPSS have completed and passed FIT	- TPSS L2 testing - fiber between TPSSs

S1-304	Overcurrent Relay / Pull-Away	Demonstrate that TPSS have completed and passed FIT	- SIT TPSS L2 testing - SIT 301 Live Wire OCS Approved
S1-305	Rail / Earth / Isolation / Detection	Civil R2G testing approved	All rail interfacing equipment installed
S1-401	Train Control / Track Circuit Shunting		- Signals L2 testing - SIT 301 Live Wire OCS Approved
S1-402	Train to Wayside Comms (TWC)		- Signals L2 testing - SIT 301 Live Wire OCS Approved
S1-403	Control Line / In Cab Signaling		- Signals L2 testing - SIT 301 Live Wire OCS Approved
S1-404	Train Tracking		- Signals L2 testing - SIT 301 Live Wire OCS Approved
S1-405	Signal Aspect Sighting		- Signals L2 testing - SIT 301 Live Wire OCS Approved
S1-406	Control Line Braking Distance		- Signals L2 testing - SIT 301 Live Wire OCS Approved
S1-407	Wayside Sign / Marker Visibility		- Signals L2 testing - SIT 301 Live Wire OCS Approved
S1-408	Traffic Signal Interface	Traffic signal's installed	- Signals L2 testing - SIT 301 SIT 301 Live Wire OCS Approved - City traffic signal interfaces commissioned
S1-501a	EFN Test (Emerg Fire Network)	Permanent power energized to rooms or cabinets housing network switches.	Fiber network and switches fully run, terminated and continuity confirmed.

S1-501b	TCN Test (Train Control Network)		Fiber network and switches fully run & terminated
S1-502	EVS Tunnel Airflow Test	- Level 1 and 2 testing for all components associated with tunnel ventilation. - Ventilation shafts and elevators complete. - Station and cross passage doors installed and tested.	- EFN fiber network complete
S1-503	EVS Sequence Testing	- Level 1 and 2 testing for all components associated with tunnel ventilation. - Level 1 and 2 testing complete for all building systems and fire alarm systems that respond to emergency events.	- PIMS Commissioned - SCADA installed on server (or laptop) - Factory Integrated Acceptance Test
S1-504	SCADA TCS Test		- TCN fiber network complete - SCADA installed on server (or laptop)
S1-505	SCADA BMS Test	Level 1 and 2 testing for all components associated with BMS complete.	- TCN fiber network complete - SCADA installed on server (or laptop)
S1-506	PA/VMS/VES & ERM Verification	Level 1 and 2 testing for all components associated with EVS, BMS and Fire Alarm.	- PA, VMS, VES, EVS, BMS fully commissioned - PIMS Commissioned

Notes:

- Switches shall be clamped and blocked and only hand thrown until SIT 202 is complete
- SIT 303 should be completed prior to new substations used for train testing
- SIT 305a should be completed before live train testing
- Temp train speed signs posted until SIT 403
- Crossings should be protected (flaggers) until all SIT 400 level's are completed.

END OF ATTACHMENTS

Div 2

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SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for demolition, removal, and disposal of surface and subsurface structures, and related ancillary components.
 - a. Work must include removal, relocation and disposal of all existing materials and equipment as indicated on the issued for Construction Drawings and as needed for a complete installation of all improvements. Variations must be reported to the Resident Engineer.
 - b. Work must include shut-off, disconnection and removal of mechanical, plumbing, HVAC, and fire protection systems and equipment and building electrical systems from existing tunnels and buildings, including those in WSDOT facilities.
 - c. Work must include rodent/pest control.
 - d. Surveys must be in accordance with Migratory Bird Treaty Act (MBTA).
2. Abatement and disposal of Hazardous and Contaminated Substances must be in accordance with the Contract and local, state, and federal regulations.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. Authority Having Jurisdiction (AHJ):
 - a. Standard plans and specifications.
2. American National Standards Institute (ANSI):
 - a. ANSI A10.6 Safety and Health Program Requirements for Demolition Operations.
3. Washington State Department of Transportation (WSDOT):
 - a. Standard Specifications for Road, Bridge, and Municipal Construction.
4. Washington Administrative Code (WAC):
 - a. WAC 296-155 "Safety Standards for Construction Work", Part S "Demolition".
5. U.S. Fish and Wildlife Service:
 - a. Migratory Bird Treaty Act (MBTA) 1918.

B. Definitions:

1. Structure: Facilities including but not limited to buildings, bridges, walls, slabs, beams, foundations, footings, piles, foundation systems, drainage structures, loading docks, stairs, and canopies.
2. Asphalt Concrete Pavements: Streets, driveways, alleyways, or other surfaces constructed from bituminous mix, or any combination of bituminous mixes or surface treatments.
3. Concrete Pavements: Streets, driveways, alleyways, or other slabs greater than six inches in thickness, constructed from Portland Cement Concrete, including those constructed with or without an asphaltic overlay.
4. Concrete Sidewalks: Concrete slabs six inches or less in thickness, with or without asphaltic overlay, also including curbs, gutters and ramps.

1.03 COORDINATION

- A. Contractor must hold a preconstruction meeting to discuss the approved Construction Work Plan (CWP). The CWP must address hold points, schedule of work and related approved submittals.
- B. Prior to commencing any work, Contractor must provide minimum of 30 days notice to schedule meeting(s) with Resident Engineer to discuss the work plan and schedule.
- C. Contractor must obtain required permit(s) for the work from AHJ.

1.04 SUBMITTALS

A. Submit:

1. Demolition and Removal Construction Work Plan:
 - a. Work Plan must include the following:
 - 1) Demolition schedule, including timing for utility disconnects and durations of parking lot or roadway and traffic impacts.
 - 2) As-Built Drawing(s) of surveyed locations and depths of disconnected utilities, walls, and foundations left on site as required by the Contract.
 - 3) Description and shop drawings of method and sequence of demolition and removal for all stages.
 - 4) Description of equipment types to be used in all demolition and removal operations.
 - 5) Description of method and equipment to be used for containment, collection, salvage, recycling, or disposal of all debris.
 - 6) Description of haul routes and access points.
 - 7) Location of approved disposal sites.
 - 8) Field measurements of items and members of the existing structure prior to preparing shop drawings for concrete elements.

- 9) Plans and calculations for false works, prepared by a registered Professional Engineer in the State of Washington, to be used for the demolition of existing structures.
- 10) Temporary storage location for rail scheduled to be removed or reused as guardrail.
- 11) Description of cleanup and site restoration methods.
- 12) Survey plan coordination for Migratory Bird Treaty Act (MBTA) work and schedule as identified in this Section.
- 13) Plan for response, characterization, managing and disposal of Known and Unknown Hazardous or Contaminated Substances including but not limited to Hazardous Building Materials and Hazardous or Contaminated Substances associated with utilities such as asbestos cement pipe/or and sediment/sludge remaining in utility pipes, catch basins or sumps.
- 14) Plan to confirm Hazardous Building Material Certificate of Clearance as required by the Contract, is complete prior to beginning demolition.

2. Final Demolition Examination Report.

B. Transmit:

1. Waste Management Progress Reports.
2. Utility Severance Certificates.
3. Rodent Control Inspection and Extermination Statement:
 - a. After initial treatment, submit a statement signed by the pest control operator.
 - b. For each follow-up inspection, report the types and amount of baits placed in each location.
 - c. State the visible results obtained from the rodent control program.
4. Letter verifying re-establishment of survey markers and monuments, signed by a land surveyor licensed in the State of Washington.
5. Private Property Owner's Release: If material demolished and removed from the site will be deposited on private property, submit two copies of written releases to the Resident Engineer. Releases must absolve Sound Transit from responsibility concerning the depositing of material on private property, and the owners of the property must sign releases on which the material will be deposited.

1.05 QUALITY ASSURANCE

- A. The issued for Construction Drawings are produced from original as-built drawings and field observations. The issued for Construction Drawings may not fully represent an accurate as-built condition. The issued for Construction Drawings of existing conditions are for Contractor's general reference and orientation. Discrepancies may be encountered. Contractor must carefully examine and field verify all conditions, including extent of materials remaining in buildings on site. Contractor must give attention and protection to existing structures, utilities, and equipment that are to remain.

- B. It is solely the Contractor's responsibility to determine demolition procedures and sequences to ensure the safety of operation. This may include the use of temporary shoring or bracing. If during demolition, damages are made to structures or utilities, Contractor must perform repair and restoration promptly at no cost to owner.

PART 2 - PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

- A. Products for patching, extending, and matching must be the same types as those used in existing facility, and in accordance with AHJ requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to beginning demolition, Contractor must make a complete inspection of the project conditions, including existing visible defects. Visible defects must be photographed and logged by the Contractor and verified by the Resident Engineer.
- B. Perform surveys and potholes to locate existing drainage and utilities. Contractor must prepare Construction Drawings to depict existing utilities. Protect existing utilities and drainage to remain from damage.
- C. Survey for Migratory Bird Treaty Act (MBTA):
 - 1. Submit a request to Sound Transit for survey in accordance with Migratory Bird Treaty Act (MBTA), if the construction work commences during nesting season. Nesting season may vary due to weather conditions and must be confirmed prior to any construction work commences:
 - a. If the construction work commences outside of nesting season, survey for Migratory Bird Treaty Act (MBTA) is not required. Contractor must verify with Sound Transit Environmental team and confirm the requirements for survey prior to commencing any construction work.
 - b. Request all surveys a minimum of two (2) months prior to demolition work:
 - 1) Surveys must occur within one (1) week prior to any demolition activities and additional surveys as required by permitting agencies.
 - c. Sound Transit will provide written approval to commence demolition if MBTA survey is complete and does not require any additional coordination:
 - 15) If MBTA bird species are present in the demolition area, Contractor must not commence any work until Sound Transit provides written approval to commence work.
- D. Existing Structures and utilities may contain Hazardous or Contaminated Substances including asbestos, lead, PCBs, mercury, and other hazardous substances. It is the Contractor's responsibility to characterize and dispose of Hazardous or Contaminated Substances in accordance with the Contract and local, state, federal regulations.

3.02 PREPARATION

A. Rodent/Pest Control Inspection and Extermination:

1. Secure a registered sanitarian in the State of Washington to conduct a survey for evidence of current rodent/pest activity.
2. Initiate a control program by a health department certified pest control operator, if the survey indicates that it is necessary. The control program must include the following minimum requirements:
 - a. At least 10 days before demolition begins, purge the work area of rodents and prevent their migration to adjacent areas. Maintain rodent-free state for three months. As directed by the Resident Engineer, execute rodent control and extermination within a one-block radius of the work area, with the permission of property owners or tenants.
 - b. Place required and approved quantity of toxic bait by the pest control operator in the form of paraffinized block, in each manhole or storm drain inlet located on the same street as the facility (to be demolished), as well as at its closest intersection(s). Additional baits must be placed, as determined by the pest control operator.
 - c. Where there is no competing water supply, use liquid anticoagulant baits at the discretion of the certified pesticide applicator.
 - d. Inspect toxic baits and renew as necessary on the fourth or fifth day after initial baiting, and every seven days thereafter.
 - e. Remove and dispose of rodent carcasses in sealed plastic bags.
 - f. Submit a statement signed by the pest control operator, after the initial treatment. For each follow-up inspection, report the types and amount of baits placed in each location; state the visible results obtained from the rodent control program.
 - g. Remove bait blocks upon completion of project.

B. Salvage:

1. Sound Transit will perform salvage of limited landscaping materials and building interior materials such as trim, interior doors, appliances, plumbing fixtures and light fixtures prior to Notice to Proceed for the Contract. Salvage operations must be performed under a separate contract with Sound Transit. Remove any items remaining in the buildings as part of the demolition work.
2. Remove additional salvage items that don't impact structural integrity for salvage prior to demolition include the following:
 - a. Copper.
 - b. Glu-lam beams.
 - c. Vertical timbers.
 - d. Wood decking.
 - e. Structural beams.

- f. Porch columns.
 - g. Exterior windows.
 - h. Vinyl windows.
 - i. Exterior doors.
 - j. Granite.
 - k. Brick.
 - l. Elevator equipment.
- C. Install temporary chain link fencing to secure all work areas, as indicated on the issued for Construction Drawings.
 - D. Remove trees, shrubs, and other vegetation within construction limits, except those identified to be protected in the Contract.
 - E. Protect trees and shrubs outside of construction limits and street trees within construction limits.

3.03 DEMOLITION OPERATIONS

- A. Perform demolition in accordance with the approved Demolition and Removal Construction Work Plan. Use methods within limitations of governing regulations. Demolition must be done safely and must avoid damaging any portions of the Structure that are to remain. Observe Federal, local and state codes, including WAC 296-155 "Safety Standards for Construction Work", Part S "Demolition", at all times. The Contractor must review all Construction Drawings of the existing Structure noted in the Contract.
- B. Exercise pollution controls as specified in the Contract.
- C. Demolish and remove existing construction only to the extent required by Construction Drawings.
- D. Cut demolition lines and openings true to dimensions required. Use cutting methods that minimize damage and disturbance to remaining construction. Provide temporary covers over openings.
- E. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- F. Do not use cutting torches until work area is cleared of flammable materials. Verify condition and contents within concealed spaces, such as ducts and pipes, before starting flame-cutting operations. Maintain ventilation and keep portable fire-suppression devices nearby, during flame-cutting operations.
- G. Do not use explosives.
- H. Perform demolition by means that protect the public, workers, and existing materials.
- I. Remove and lower framing members to ground, by means to prevent free fall, ground impact, and dust generation.
- J. Avoid overloading existing construction when placing demolition equipment and removing debris.

- K. Completely fill abandoned pipes with Controlled Density Fill (CDF) in accordance with AHJ and manufacturer requirements. CDF must meet the requirements of WSDOT Standard Specifications for Road, Bridge and Municipal Construction.
- L. Abandon catch basins, valve chambers, manholes, oil water separators, sumps, vaults, septic tanks, and inlets as shown on the plans in accordance with AHJ requirements and WSDOT Standard Spec Section 7-05.3(2).
- M. When Hazardous or Contaminated Substances are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, disposal, and protection against exposure to environmental pollution.

3.04 REMOVAL

- A. Except for items or materials indicated in the Waste Management Plan to be reused, salvaged, recycled, reinstalled, or otherwise indicated to remain Sound Transit's property, Contractor must remove and transport demolished materials from Work site and legally dispose:
 - 1. Do not allow demolished materials, including those to be salvaged, recycled, or disposed to accumulate on site. Remove materials from building and work site regularly, so their presence will not create unsafe conditions for workers and the public.
 - 2. Comply with AHJ requirements regarding handling, removal, hauling, and disposal of materials.
 - 3. Prevent spillage during removal and transporting of materials.
 - 4. Do not burn or bury materials.
- B. Except for items indicated for salvage or reuse, material removed become the Contractor's property and must be removed from the Site before completion of project.

3.05 RESTORATION

- A. When non-scheduled items are demolished or removed, replace items as directed by the Resident Engineer.
- B. Repair and restore damaged facilities, caused by demolition and operation, to their original conditions or better.
- C. Backfill and level depressions caused by demolition and operation. Grade ground surface as indicated on the issued for Construction Drawings and eliminate water pockets.
- D. Remove temporary chain link fencing, barriers, and safety guards upon completion of work.

3.06 FIELD QUALITY CONTROL

- A. At completion of demolition, the Contractor must make examination of exposed components and possible damage caused by demolition work. Submit Final Examination report to the Resident Engineer for approval.

3.07 CLEANING

- A. Maintain a clean and orderly work site.

- B. Clean adjacent facilities; remove dust, dirt, and debris caused by demolition operations. Return adjacent facilities to previously existing or better condition, prior to demolition operations.

3.08 PROTECTION

- A. Protect remaining work and adjacent facilities from damage. Do not interfere with neighboring buildings, facilities, or activities.
- B. Provide bracing and shoring to maintain the stability of existing facilities and construction.
- C. Provide barriers, safety guards, and warning lights near openings and depressions. Operate warning lights from dusk to dawn daily.
- D. Provide environmental protection as required by the Contract and local, state and federal regulations to prevent refuse, dust and waste from entering waterways, air or utility drains.
- E. Preservation of Reference Markers:
 - 1. Record the locations and designation of survey markers and monuments, prior to their removal. Provide three reference points for each survey marker and monument removed. Establish reference points by a land surveyor licensed in the State of Washington.
 - 2. Store and protect removed markers and monuments during demolition work. Replace and re-establish survey markers and monuments in conformance with the recorded reference points, upon completion of work.
- F. Protection of Utilities:
 - 1. Protect utilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by the demolition operations.
 - 2. Arrange for and verify temporary termination of utility services encountered and as indicated on issued for Construction Drawings, in conformance with AHJ.
 - 3. If utility is damaged, immediately notify the Resident Engineer and the utility owner for corrective action.

END OF SECTION

Div 3

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SECTION 03 15 25
ANCHORAGE TO CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for anchoring systems to attach structural steel and metal fabrications or equipment to concrete or concrete masonry. Specifications are included for reinforcement dowels to attach concrete to concrete or concrete masonry.
2. Provisions for vibratory anchorage design for mechanical equipment are given in Sound Transit Standard Specifications Division 22 – Plumbing and Division 23 – Heating, Ventilation, and Air Conditioning.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the documents:

1. American Concrete Institute (ACI).
 - a. ACI 318 Building Code Requirements for Structural Concrete.
 - b. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete.
2. American National Standards Institute (ANSI):
 - a. B212.15 Cutting Tools - Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills.
3. American Society for Testing and Materials International (ASTM):
 - a. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - b. ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - c. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.
 - d. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - e. ASTM A706 Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - f. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

- g. ASTM F2329 Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- h. ASTM F436 Standard Specification for Hardened Steel Washers.
- 4. American National Standards Institute/American Welding Society (ANSI/AWS):
 - a. ANSI/AWS D1.1 Structural Welding Code – Steel.
 - b. ANSI/AWS D1.4 Structural Welding Code – Reinforcing Steel.
 - c. AAASHTO/AWS D1.5 Bridge Welding Code.
- 5. International Code Council – Evaluation Service (ICC-ES):
 - a. ICC-ES AC 193 Mechanical Anchors in Concrete Elements.
 - b. ICC-ES AC 308 Post-Installed Adhesive Anchors in Concrete Elements.

1.03 SUBMITTALS

A. Submit:

- 1. For deferred design that is performed by the subcontractor, in advance of anchor installation, submit to the Resident Engineer the calculation set of anchorage design sealed by a Professional Engineer licensed in the State of Washington for approval.
- 2. Embedment shop drawings that include the embed plate fabrication shop drawing and the plans/ elevations showing the exact location of the embed in wall, column, slab, beam or other concrete element. Dimension this position from the gridlines and floor levels or other major geometry key. The Coordinate the embed position drawing with the related formwork, rebar and mechanical/ electrical/ plumbing embeds shop drawings before submitting for review. The review and approval of anchor shop drawings, erection drawings and anchor design calculations must consider all anchor attachments by other trades.
- 3. Photos of desired post-installed concrete anchors with locations of reinforcement identified by scanning.
- 4. Failed Anchor or Dowel Documentation: Documentation for anchors or dowels for an anchor or dowel that does not pass the test acceptance criteria specified in this specification. Submit failed anchor or dowel documentation to the Resident Engineer. The documentation must include, but not be limited to, the following:
 - a. Exact location of failed anchor.
 - b. Reason for failure.
 - c. Repair steps taken.
 - d. Inspector's name.
 - e. Date of test.

B. Transmit:

- 1. Product Data:

- a. Manufacturer's name.
 - b. Product Series/Catalog No.
 - c. Testing results.
 - d. Mill certificates.
 - e. Certificate of material origin.
 - f. Certificate of compliance.
2. Cast-In Concrete Anchors:
- a. Mill certificates demonstrating conformance.
3. Post-Installed Concrete Anchors or dowels:
- a. Manufacturer's Product Data demonstrating conformance.
 - b. Manufacturer's written instructions for storage, handling, and installation.
4. Welding: See Section 05 05 23 - Metal Fastening
5. Source Quality Control inspection and test reports.
6. Field Quality Control inspection and test reports.
7. Qualifications:
- a. Professional Engineer: License number and current work history.
 - b. Post-Installed Anchor or Dowel Installer.

1.04 QUALITY ASSURANCE

- A. Welder Certification: Current Washington Association of Building Officials certification for each process, method, position, and size of weld executed.
- B. Weld Procedure Specification: ANSI/AWS D1.1, D1.4, or D1.5.
- C. Post Installed anchors or dowels:
 - 1. Provide an on-site Quality Control Program for all post-installed adhesive anchors or dowels in accordance with ICC-ES AC308 Articles 14.3 and 14.4.
 - 2. Post-installed anchors or dowels must be installed by an installer with a minimum of five years' experience performing similar installations.
 - 3. Installer Training: Conduct thorough training with the manufacturer or the manufacturer's representative for the installer on the Project. Training must consist of a review of the complete installation process for drilled-in anchors including, but not limited to, the following:
 - a. Hole drilling procedure.
 - b. Hole preparation and cleaning technique.
 - c. Adhesive injection technique and dispenser training/maintenance.
 - d. Anchor element type, material, diameter, and length.
 - e. Proof loading/torquing.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cast-in concrete anchor materials to the fabricator tied and identified with plastic tags indicating the mill, melt or heat number, and the grade and size of bar.
- B. Store and handle concrete anchors in conformance with manufacturer's written instructions.

1.06 SOURCE QUALITY CONTROL

- A. All shop welds must be visually inspected.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. Post-Installed Concrete Anchors and Dowels:
 - 1. Expansion Anchors:
 - a. Hilti Kwik Bolt TZ, DeWalt Power-Stud+SD2, Simpson Strong-Bolt 2, or approved equal.
 - 2. Adhesive Anchors:
 - a. Adhesive: Hilti HIT-RE 500-V3, DeWalt Pure110+, Simpson Set-XP, or approved equal.
 - 3. Undercut Anchors:
 - a. Hilti HDA Undercut, DeWalt Atomic+ Undercut, Simpson Torq-Cut, or approved equal.
 - 4. Screw Anchors:
 - a. Hilti Kwik HUS-, DeWalt Screw-Bolt+, Simpson Titen HD, or approved equal. Limit the use of permanent screw anchors for non-corrosive interior applications only.
 - 5. Substitute Products: Substitute post-installed concrete anchor products, if submitted, must have current International Code Council Evaluation Service (ICC-ES) or International Association of Plumbing and Mechanical Officials (IAPMO) code report approval for use in cracked concrete.
 - 6. Unless noted otherwise, use galvanized post-installed anchors, or approved equal.
 - 7. Post-installed rebar dowels: ASTM A615/A706, unless noted otherwise.
- B. Post-Installed Masonry Anchors:
 - 1. Adhesive Anchors:
 - a. Hilti HIT-HY 270, DeWalt AC100+ Gold, Simpson Set-XP, or approved equal.

2. Screw Anchors:
 - a. Hilti Kwik HUS, DeWalt Screw-Bolt+, Simpson Titen HS, or approved equal. Limit the use of permanent screw anchors for non-corrosive interior applications only.
3. Substitute Products: Substitute post-installed masonry anchor products, if submitted, must have current International Code Council Evaluation Service (ICC-ES) or International Association of Plumbing and Mechanical Officials (IAPMO) code report approval for use in cracked concrete.

2.02 MATERIALS

- A. Cast-in Concrete Anchors:
 1. Reinforcing Bars: ASTM A615/A706, unless noted otherwise.
 2. Anchor Rods:
 - a. ASTM F1554 Grade 36 with ASTM A563A hex nuts.
 - b. ASTM F1554 Grade 55 S1 with ASTM A563A heavy hex nuts.
 - c. ASTM F1554 Grade 105 with ASTM A563DH heavy hex nuts.
 - d. Washers: ASTM F436.
 3. Welded Headed Studs: ASTM A108, grades 1015 through 1020, headed stud type, cold finished carbon steel, AWS D1.1, Type B; with fluxed end conforming to ANSI/AWS D1.1.
 4. Deformed Bar Anchors: ASTM A1064 with fluxed end conforming to ANSI/AWS D1.1.
- B. Welding electrode:
 1. Match filler metal requirements in conformance with ANSI/AWS D1.1, D1.4, or AASHTO/AWS D1.5.

2.03 FABRICATION

- A. Reinforcing Bars Specification ASTM A706:
 1. Fabrication: Section 03 20 00 - Concrete Reinforcing.
 2. Welding: ANSI/AWS D1.4.
- B. Welded Headed Studs: Weld to structural steel and metal fabrications in conformance with ANSI/AWS D1.1 and manufacturer's written instructions.
- C. Deformed Bar Anchors: Weld to structural steel and metal fabrications in conformance with ANSI/AWS D1.1 and manufacturer's written instructions.

2.04 FINISHES

- A. Cast-in Concrete Anchors:
 1. Anchor Rods:
 - a. Galvanized Carbon and Alloy Steel: ASTM F2329.

- b. Stainless Steel: ASTM F593 Grade 316 CW with ASTM F594 hex nuts and ASTM A240 washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Cast-In Concrete Anchors:

- 1. Anchor Rods: Install anchors as indicated on Issued for Construction Drawings. Secure to formwork or reinforcement to prevent movement during concrete placement. Protect threads until structural steel or metal fabrication is installed.

B. Post-Installed Concrete Anchors or Dowels:

- 1. Install post-installed anchors or dowels in sound concrete only. Report surfaces showing obvious distress by way of porosity, disintegration, carbonation, and cracks over 0.02-inch in width and 12-inches or longer and within the distance of the embedment length to the Resident Engineer:
- 2. Preparation for drilling:
 - a. Scan and identify existing reinforcement must be on surface prior to drilling. Scanning using non-destructive X-ray or ground-penetrating radar procedures is permitted. This includes scanning for both top and bottom surfaces of concrete if the Issued for Construction Drawings indicate there are multiple reinforcement layers. Identify other non-reinforcement embeds. Leave adequate distance between the post-installed anchor or dowel and existing reinforcement or embeds locations to account for scan tolerance.
 - b. No cutting of reinforcement is permitted without prior written approval from the Resident Engineer. Multi-cutting of the same bar is considered as one cut.
 - c. Reinforcement is considered to be cut if:
 - 1) For No. 4 through No. 7: Cuts, nicks, or drill into bar body are greater than 1/16-inch.
 - 2) For No. 8 and Larger: Cuts, nicks, or drill into bar body are greater than 1/8-inch.
 - d. When installing anchors through cut reinforcement, locate the anchoring mechanism at least two anchor diameters beyond the cut reinforcement.
 - e. If the desired location of the anchor(s) conflicts with reinforcement that is not permitted to be cut, relocate the anchor upon approval from the Resident Engineer.
- 3. Install post-installed anchors in accordance with the ICC-ES/IAPMO reports and manufacturer's installation instructions. Where installation criteria differ, the order of precedence from highest to lowest is: 1) this Specification; 2) the ICC-ES/IAPMO reports; 3) the manufacturer's installation instructions.
- 4. Drill holes for post-installed anchors with carbide-tipped bits using rotary hammer drills meeting the requirements of ANSI B212.15 unless ICC-ES AC193 or ICC-ES

AC308 testing demonstrates that using percussive drilling or another type(s) of bit, including core drills, is acceptable. Clean drilled holes of chips, dust, loose material, and water prior to anchor installation. The hole diameters and depths are per the manufacturer's instructions. Check the hole diameter every ten holes for conformance to the hole tolerances specified in ICC-ES AC308 for adhesive anchors, ICC-ES AC193 or ACI 355.2 for mechanical anchors. Verify depth of the concrete member before drilling holes. For embedment depth of the post-installed anchor, do not exceed the greater of 2/3 of the concrete member thickness or the concrete member thickness minus 4-inches, or what is allowed by the manufacturer. Contact the Resident Engineer if these requirements cannot be met based on the actual member thickness.

5. Install anchors or dowels perpendicular to the concrete surface within a plus or minus 5-degree tolerance. Visual inspection for post-installation verification of this criterion is acceptable to verify proper seating of the nut and washer.
6. In areas where concrete has been removed, measure the minimum anchor embedment from the surface of sound concrete.
7. Unless otherwise noted on the Issued for Construction Drawings, use the spacing requirements indicated in the applicable ICC ES/IAPMO report.
8. Bending and welding of post-installed anchors is not permitted.
9. The nut thread engagement for the anchors (studs) must be such that the bolt threads project past the outside face of the nut when completely installed.
10. Do not damage the length identification code on the head of the anchor during installation. Anchor projection to be cut-off is subject to the approval of the Engineer of Record and documentation of the location, embedment, and length code.
11. Drive in unused anchors and cut-off flush. Cut-off anchors are considered an abandoned ungrouted hole for future anchor spacing requirements.
12. Avoid bending anchors to match base plate holes or loosening of anchors by prying sideways after tightening. Ensure that the cone nut of an undercut anchors does not become loose from the stud during the setting or tensioning operation.
13. Non-grouted base plates with a maximum 1/8-inch gap is acceptable as evidenced under exterior edges around the plate provided that 1) the plate exhibits bearing contact within its interior against the concrete surface; and 2) the uneven bearing does not prevent application of the prescribed torque. If an unacceptable bearing contact condition exists, one of the following procedures applies:
 - a. Rework the concrete surface to obtain a proper fit.
 - b. For gaps of up to 1-inch, grout the base plate instead, using the following technique:
 - 1) Insert post-installed anchors and set the base plate.
 - 2) Insert nuts to finger-tight condition.
 - 3) Install shims positioned no more than 1/2-inch away from the anchors to reduce gaps between base plate shims to 1/8-inch or less at anchor locations.

- 4) Apply tightening torque. Do not tighten the bolt when interior shims under the base plates have been placed away from anchors so that downward bending of the base plate would result upon tightening. Move shims as close as possible to the anchors before applying the installation torque.
 - 5) Fill the gap with non-shrink grout leaving the shims in place. For base plates on walls where grouting is not feasible, fill the gap with shim plates. Stack the shims but with no more than four shims.
14. Relocating Holes Within Base Plates: Relocate the base plate with bolts no more than 1-inch in any direction with respect to the attachment principal axis unless otherwise noted on the Issued for Construction Drawings.
 15. Do not use adhesive anchors for conditions that place constant tensile loads on the anchor.

3.02 FIELD QUALITY CONTROL

A. Post-Installed Concrete Anchors and Dowels:

1. Require full-time special inspection for all adhesive anchor systems together with proof load testing. Proof load testing only does not meet special inspection requirements.
2. Test (Proof) Load: Indicate Tension test (proof) load on the approved shop drawings:
 - a. For post-installed adhesive anchors or dowels, perform a confined test in accordance with ICC-ES AC308 which is equal to the lesser of:
 - 1) A tensile load equal to 80-percent of the specified nominal yield strength of the anchor bolt material times the tensile area of the bolt; or
 - 2) A tensile load equal to twice the design load and at least 50 percent of the expected ultimate load based on the adhesive bond strength shown in the ICC-ES/IAPMO report, whichever is greater.
3. For post-installed mechanical anchors, perform an unconfined test in accordance with ASTM E488 or ACI 355.2 equal to the lesser of the following. Retighten post-installed anchors tested by this method by applying the installation torque:
 - a. Tensile load equal to 80-percent of the specified nominal yield strength of the anchor bolt material times the tensile area of the bolt.
 - b. Tensile load based on a multiplied amplification factor of the anchor design capacity as provided in an approved evaluation report as one of the following:
 - 1) Twice (2x) the maximum allowable tension load (Allowable Stress Design).
 - 2) One and a quarter (1-1/4x) times the maximum design strength of the anchor (Ultimate, LRFD based load capacity).
4. Test Frequency: Unless otherwise specified, the following test frequencies must apply:

Post-Installed Anchor & Rebar Dowel Testing Frequency			
Test Category	Condition	Initial Test Frequency	Notes
A	All except conditions listed in B below.	100 percent or twenty (20) in single application, whichever is less. Examples of single application: anchor bolt group for one equipment, rebar dowels of same diameter installed to one beam.	- Testing frequency is only reduced in a single application and subject to the approval of the Resident Engineer and is not to be less than 25 percent or twenty (20), whichever is less. - In the next application, location or occasion, or should any anchor tests fail, reset the testing frequency to initial frequency. - Do not reduce the number of tests on any adhesive anchor/ dowel installed overhead. - Do not reduce the number of tests on any adhesive anchor/ dowel installed in plinth. - Anchors to be tested must be randomly selected by the inspector and tested in the presence of the inspector.
B	- Post-installed anchors to wall with load $\leq$ 250lbs. - Post-installed anchors to paving for sign posts $\leq$ 6 ft. in. height and $\leq$ 100 lbs. - Post-installed mechanical anchors supporting distributed systems weighing $\leq$ 5 lb./ft.	10 percent or minimum of five (5) whichever is greater, in any single application	Increase testing to 50 percent if any anchor fails until 10 anchors not previously tested and randomly selected by the inspector pass, then resume initial test frequency.

5. Acceptance Criteria: A post-installed anchor is acceptable if the test load specified in this specification is attained without:
 - a. Slippage of more than:
 - 1) 1/16-inch for adhesive anchors
 - 2) 2.5-percent of the embedded length, rounded to the nearest 1/16-inch for mechanical anchors
 - b. Bolt failure

- c. A sign of damage in the surrounding concrete.

6. Installation Inspection Record:

- a. Test Inspection Record: Include in the test inspection record, but not be limited to, the following information:
 - 1) Product description, including product name.
 - 2) Adhesive expiration date.
 - 3) Anchor or rebar diameter and steel grade.
 - 4) General location of anchor and group represented.
 - 5) Method of test or verification.
 - 6) Test results, accepted or rejected.
 - 7) Inspector's name.
 - 8) Date of test.
 - 9) Identification number of testing tool.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for conveying, placing, finishing, curing, protecting, and testing cast-in-place concrete.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. American Concrete Institute (ACI):
 - a. ACI SPEC-301 Specifications for Concrete Construction.
 - b. ACI PRC-304 Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - c. ACI PRC-304.2R Guide to Placing Concrete by Pumping Methods.
 - d. ACI PRC-305R Guide to Hot Weather Concreting.
 - e. ACI SPEC-306.1 Standard Specification for Cold Weather Concreting.
 - f. ACI PRC 308R – Guide to External Curing of Concrete
 - g. ACI PRC-309 Guide for Consolidation of Concrete.
 - h. ACI 503.2-503.4 Three Epoxy Specifications.
2. American Society for Testing and Materials (ASTM) International:
 - a. ASTM C31/C31M Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - b. ASTM C33/C33M Standard Specification for Concrete Aggregates.
 - c. ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - d. ASTM C42/C42M Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - e. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete.
 - f. ASTM C143/C143M Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - g. ASTM C150/C150M Standard Specification for Portland Cement.

- h. ASTM C171 Standard Specification for Sheet Materials for Curing Concrete.
- i. ASTM C172/C172M Standard Practice for Sampling Freshly Mixed Concrete.
- j. ASTM C231/C231M Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- k. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- l. ASTM C470/C470M Standard Specification for Molds for Forming Concrete Test Cylinders Vertically.
- m. ASTM C881/C881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- n. ASTM C928/C928M Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.
- o. ASTM C1059/C1059M Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
- p. ASTM C1064/C1064M Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
- q. ASTM C1702 Standard Test Method for Measurement of Heat of Hydration of Hydraulic Cementitious Materials Using Isothermal Conduction Calorimetry.
- r. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- s. ASTM E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- 3. American Association of State Highway and Transportation Officials (AASHTO):
 - a. AASHTO M182 Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
- 4. Washington State Department of Transportation (WSDOT):
 - a. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.
- 5. City of Seattle:
 - a. Standard Specifications for Road, Bridge, and Municipal Construction.

B. Definitions:

- 1. **Mass Concrete:** Structural concrete is defined as mass concrete when the minimum cross sectional dimension is equal to or greater than 4 feet, or when Type III cement, accelerating admixtures, or cementitious materials in excess of 660 lb/yd³ of concrete are used. Concrete used in shafts meeting drilled shaft concrete mix requirements, a maximum temperature at placement of 70 degrees Fahrenheit, and a minimum amount of 25 percent fly ash or 35 percent slag are

excluded from mass concrete requirements. Exemptions from mass concrete are subject to review and approval process by the Resident Engineer.

1.03 SUBMITTALS

A. Submit

1. Construction Work Plan including provisions for hot weather concreting and curing, cold weather concreting and curing, and wet weather concreting and curing. Provide concrete vibration procedure and description of methods to prevent the formation of aggregate pockets.
2. Shop Drawings for Cast-In-Place Prestressed Concrete: Drawings must be in accordance with WSDOT Standard Specifications Section 6-02.3(26)C, except that submit the drawings to Resident Engineer and not WSDOT as indicated in the submittal procedures.
3. Thermal Control Plan: Mass Concrete
4. Concrete Pre-Pour Hold Point Checklist, see Article 1.04, in this specification.

B. Transmit:

1. For each manufactured product, submit:
 - a. Manufacturer's Product Data showing conformance with the requirements of this Section.
 - b. Material Data and Safety Sheets.
 - c. Manufacturer's written instructions for storage, handling, and installation
2. Qualifications:
 - a. Certificate of accreditation for Independent Testing Laboratory Technicians in accordance with ASTM E329 for technical competence to perform specific tests required.
 - b. Qualifications of concrete placement technicians in accordance with Article 1.04A.
3. Placement Records: Report the location in the finished work of each concrete class, and the start and completion times of each batch of concrete placed.
4. Field Quality Control inspection and test reports and documents:
 - a. Concrete slump, air content, and temperature results.
 - b. Concrete compressive strength test results.
 - c. Concrete truck batch tickets in conformance with ASTM C94/C94M. Include any modifications to water or admixture volumes from the original mix design.
 - d. Thermal control records
 - e. Qualifications of Independent Testing Laboratory Technician

1.04 QUALITY ASSURANCE

- A. Concrete Placement Personnel: The Contractor's personnel responsible for carrying out concrete activities must possess skills and prior experience in the specific type of work necessary to effectively perform the responsibilities for concrete placement. Only technicians whose qualifications have been reviewed by the Resident Engineer are permitted to be assigned to carry out concrete control activities.
- B. Construction Work Plan: Include storage descriptions of methods, materials, labor, and equipment used in:
 - 1. Forming, conveying, placing, curing, and protecting cast-in-place concrete. Provide concrete vibration procedure and description of methods to prevent the formation of aggregate pockets.
 - 2. Sampling and testing cast-in-place concrete.
 - 3. Hot weather concreting, cold weather concreting, and wet weather concreting.
- C. Thermal Control Plan: Develop plan with concrete supplier describing means and methods of monitoring internal and differential temperature of mass concrete, and mitigating damage to concrete due to heat of hydration of the cement and attendant volume changes. Include the following:
 - 1. Concrete mix designs.
 - 2. Duration and methods of curing.
 - 3. Methods of controlling interior and differential concrete temperatures.
 - 4. Methods of applying immediate corrective action should the temperature limits be exceeded.
 - 5. Damage from thermal cracking, degradation of concrete strength, or delayed ettringite formation.
 - 6. Temperature monitoring system. Include system description, sensor types and locations, and manufacturer's product information. Furnish readout device with chart recorder. Furnish sample thermal control report.
 - 7. Method of sensor installation, connection to readout device, protection during placement and curing, reading, and decommissioning.
 - 8. Indicate on the concrete thermal control plan which combinations of ambient temperature, concrete temperature, and R-value of the thermal blanket are acceptable for field use. Include checking the thermal control plan as part of the pre-pour checklist. Concrete is only accepted if the combination of concrete temperature and ambient temperature is within the combination that will not exceed the maximum core temperature and maximum differential temperature.
- D. Hold points for inspection prior to concrete placement for verifying conformance of reinforcement and formwork include:
 - 1. Substrate preparation.
 - 2. Formwork and blockout installation and release agent application.
 - 3. Reinforcement, embedment for anchors and Mechanical Electrical and Plumbing (MEP), post-tensioning, waterstop product installation.

4. Cleanliness.
 5. Thermal Control application.
 6. Concrete mix design verification.
 7. Concrete Testing.
- E. Independent Testing Laboratory technicians must have ACI Grade I Concrete Field Testing Technician Certification.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Ready Mix Concrete: Section 03 05 15 - Cement Concrete.
- B. Store and handle manufactured products in conformance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. Patching Mortar: ACI 503.2-503.4 for Epoxy Mortar.
- B. Epoxy Adhesive: ASTM C881/C881M:
 1. Type II for non-load-bearing concrete, Type V for load-bearing concrete.
 2. Select grade and class by project conditions and requirements.
- C. Damp Curing Materials:
 1. Waterproof Sheet Materials: ASTM C171 waterproof paper with white paper face, polyethylene film pigmented white or white burlap-polyethylene sheeting.
 2. Burlap: AASHTO M182, class or weight suitable for the use and location.
- D. Curing Compound: ASTM C309, liquid membrane-forming curing compound:
 1. Type 1 for concrete not exposed to sunlight, Type 1-D with white fugitive dye for concrete exposed to sunlight.
 2. Class A or B as appropriate for use and location.
- E. Patching Materials Other Than Cement:
 1. Cement mortar modified with a latex bonding agent conforming to ASTM C1059/C1059M Type II.
 2. Epoxy mortars and epoxy compounds that are moisture-insensitive during application and after curing, that embody an epoxy binder conforming to ASTM C881/C881M, Type III. Select type, grade, and class appropriate for the application.
 3. Non-shrink grout: Section 03 62 00 - Non-Shrink Grout.
 4. Packaged, dry concrete repair materials conforming to ASTM C928/C928M

F. Evaporation Retarder:

1. Eucobar by Euclid Chemical.
2. Evapre by W. R. Meadows.
3. Aquafilm by Dayton Superior.

G. Vapor Retarder:

1. Carlisle Coating and Waterproofing, Inc.; Blackline400.
2. Stego Industries, LLC; Stego Wrap 15 mil Class A.
3. Grace Construction Products, W.R. Grace & Co.; Florprufe 120.
4. Raven Industries Inc.; Vapor Block 15.
5. Reef Industries, Inc.; Griffolyn Type-105.

H. Sealers:

1. Reference Specification Section 07 19 10 - Water and Graffiti Repellents.
2. Silane Sealer with 40 percent solids:
 - a. Barcade Silane 40 by Euclid Chemical.
 - b. MasterProtect H 440HZ by BASF.

2.02 MATERIALS

A. Portland and Hydraulic Cement for Site-Mixed Repair Materials:

1. ASTM C150/C150M, type and brand to match cement used in concrete to be repaired.
2. ASTM C595/C595M, type and brand to match cement used in concrete to be repaired.
3. Provide white Portland Cement where required to match surrounding concrete.

B. Fine Aggregate for Site-Mixed Repair Materials:

1. For Bonding Grout: ASTM C33/C33M washed clean sand passing a Number 30 sieve.
2. For Patching Mortar: ASTM C33/C33M washed clean, graded fine aggregate of suitable size for areas to be repaired. Aggregate up to Size Number 8 is permitted to be used for repair of larger defects.

2.03 MIX DESIGNS

A. Mix Designs: Section 03 05 15 - Cement Concrete.

2.04 MEASURING, BATCHING, AND MIXING

A. Measure, batch and mix Cement Concrete in conformance with ASTM C94:

1. Use central-mixed concrete transported to the jobsite in truck mixers.

2. Use truck mixers equipped with:
 - a. Automatic device for recording number of revolutions of drum prior to completion of mixing operation.
 - b. Either accurately calibrated water tanks or water meters.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Notification: Prior to each concrete placement:
 1. Notify the Resident Engineer at least 24 hours prior to actual placement, and not later than 3 pm on the day prior to placement.
 2. Notify the Resident Engineer at least 48 hours prior to actual placement when schedules require concrete placement at times other than normal working hours or for mass concrete pours.
 3. Notify the Resident Engineer of the location of the placement and the concrete mix to be placed.
- B. Prior to placement, verify the following:
 1. Formwork installation conforms to Section 03 11 00 - Concrete Forming.
 2. Reinforcing placement conforms to Section 03 20 00 - Concrete Reinforcing.
 3. Embedded items are located correctly and secured to resist movement.
 4. For concrete cast on earth, also verify the subgrade is well drained; free of debris, free of frost and ice; and moist with no muddy spots, soft spots, or ruts.
 5. Configuration of mild steel and post-tensioning allow for concrete flowability and consolidation.
- C. Topping Slab:
 1. Topping applied to fresh concrete: Do not begin placement of topping until water ceases to rise to surface, and water and laitance have been removed from base slab surface.
 2. Topping applied to hardened concrete: Remove dirt, loose material, oil, grease, paint and other contaminations, and leave a clean surface.
- D. Construction Joints:
 1. Locate construction joints as indicated on the Issued for Construction Documents, and according to Section 03 11 00 - Concrete Forming.
 2. Form construction joints straight and as inconspicuous as possible, and in vertical and horizontal alignment with the structure.
 3. All joints must be horizontal, vertical, or perpendicular to the main reinforcement.
 4. Do not use an edger on any construction joint, and remove any lip or edging prior to adjacent pour.

5. Install waterstops in conformance with Section 03 15 13 - Waterstops.
 6. Before placing fresh concrete against cured concrete, remove all laitance, thoroughly clean the cured surface, and intentionally roughen the surface to a full amplitude of approximately 1/4 inch.
- E. Obtain acceptance of preparation from the Resident Engineer and special inspection firm prior to placement.
 - F. Waterproofing Membrane: Where concrete is to be placed over a waterproofing membrane, obtain acceptance of the membrane integrity from the Resident Engineer prior to concrete placement.
 - G. Weather Considerations:
 1. Wet Weather: Do not place concrete while rain, sleet, or snow is falling unless protection is provided. Do not allow rain, sleet or snow to increase mixing water or damage unformed surfaces.
 2. Hot Weather: Conform to ACI 305R.
 3. Cold Weather: Conform to ACI 306.1.
- 3.02 MEASURING, BATCHING AND MIXING
- A. Measure, batch and mix Cement Concrete in conformance with ASTM C94/C94M:
 1. Use central-mixed concrete transported to the jobsite in truck mixers.
 2. Use truck mixers equipped with:
 - a. Automatic device for recording number of revolutions of drum prior to completion of mixing operation.
 - b. Either accurately calibrated water tanks or water meters.
- 3.03 DELIVERY
- A. Refer to Section 03 05 15 - Cement Concrete.
- 3.04 ADJUSTMENT
- A. For slump adjustment, refer to Section 03 05 15 - Cement Concrete.
- 3.05 PLACEMENT
- A. Conveying:
 1. General:
 - a. Convey concrete rapidly from mixer to the place of final deposit using methods that prevent segregation and loss of ingredients, and will ensure the required quality of concrete.
 - b. Do not use aluminum pipes or chutes.
 - c. Conform to ACI 304R.
 2. Pumping:
 - a. Conform to ACI 304.2R.

- b. Use pumping equipment that permits placement rates that avoid cold joints and prevent segregation in discharge of pumped concrete.
- c. Support pump hoses so that reinforcement is not moved from its original position.

B. Depositing:

- 1. Place concrete continuously in one horizontal layer or in several horizontal layers with fresh concrete deposited over previous placements that are still plastic.
- 2. Do not place concrete that has surface-dried, partially hardened, or contains foreign material.
- 3. Do not drop concrete freely through reinforcing which may cause segregation.
- 4. Do not drop concrete freely more than 5 feet. When placing vertical sections of greater heights, use openings in the form, elephant trunks, tremies, or other approved devices to reduce the free drop.
- 5. Placement Using Tremie Methods: Place concrete in or under water in conformance to ACI 304R.
- 6. When a truck is being sampled, do not place concrete until tests demonstrate the concrete conforms to temperature, air content, and slump requirements.

C. Consolidating:

- 1. Consolidate concrete by mechanical vibration in conformance with ACI 309R.
- 2. Thoroughly work concrete around reinforcement and embedded items and into corners of forms to eliminate air and rock pockets. Insert and withdraw the vibrator vertically at uniform spacing over the entire area of the placement. Space the distance between insertions such that the influence zones of each insertion overlap. Do not drag vibrators to move concrete horizontally.
- 3. Drop the vibrators to a depth as to ensure consolidation towards the bottom of all vertical elements and through congested areas. Drop vibrators to depth multiple times to bottom of elements. Keep vibrators in position for a sufficient amount of time to consolidate.
- 4. Use internal vibrators of the largest size and power that can properly be used in the Work. Maintain vibrators and provide sufficient back-up units on site.
- 5. Thoroughly and Systematically vibrate concrete placed around waterstop to avoid air entrapment, and provide positive contact between the waterstop and concrete. Prior to completion of the concrete placement, clean the exposed portion of the waterstop of all foreign objects to ensure positive contact between the waterstop and concrete.
- 6. Provide sufficient windows in the forms or limit the forms in height to allow visual observation of the concrete such that the vibrator operator can observe the concrete being consolidated to ensure good quality workmanship. Conduct vibration using competent, skilled, and experienced workers.

3.06 CURING AND PROTECTION:

- A. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces for stations and garages according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

1. Evaproation Retarder is not required when the Curing Procedures demonstrate that moisture loss will not exceed 0.2 lb/sq.ft x h (1 kg/sq.m x h) before and during finishing operations. Base such determination upon concrete mix characteristics and ambient environmental conditions at time of placement.
- B. Curing Unformed Concrete Surfaces at Station Platforms:
1. Cure the concrete surfaces in accordance with the WSDOT Standard Specifications Section 6-02.3(11)B, except as noted below:
 - a. The wet curing requirement as described must remain in place for at least 7 - consecutive calendar days.
 - b. Curing concrete by spraying curing compound only is not allowed for station platforms.
- C. Curing Unformed Concrete Surfaces other than Station Platforms:
1. Apply evaporation retardant, immediately after placing, in accordance with manufacturer's instructions.
 2. Apply curing compound in accordance with manufacturer's instructions.
- D. Curing Formed Concrete Surfaces:
1. Keep absorbent wood forms wet until they are removed.
 2. If formwork ties are loosened during curing period, moist cure after loosening forms. If removing forms before the end of curing period, apply curing compound within 10-minutes after formwork is removed.
 3. Do not loosen formwork ties prior to minimum time for form removal per Table 03 11 00-A in Section 03 11 00 - Concrete Forming.
- E. Protection:
1. Immediately after placing, protect concrete from premature drying, excessively hot or cold temperatures, mechanical injury, and staining.
 2. Protect concrete during the curing period from mechanical and physical stresses due to heavy equipment movement, avoid subjecting the concrete to load stress, load shock, or excessive vibration.
 3. Where concrete surfaces will receive architectural finishes, such as clear or penetrating pigmented sealer/densifier, resilient floor coverings or paint, ensure membrane-forming curing compound does not leave a coating or residue that will impair application or bond of sealers, adhesives, paints, and coatings with concrete.
 4. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 5. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
- F. Parking Garages:
1. See Specification Section 07 19 10 - Water and Graffiti Repellents for sealer.
 2. Cure concrete in accordance with ACI 301, including duration of curing period.

3.07 REPAIR OF SURFACE DEFECTS

A. General:

1. Where the surface is to be textured, repair tie holes and surface defects before texturing.
2. Manufactured repair materials are permitted in lieu of site-mixed repair materials. Apply manufactured repair materials in conformance with manufacturer's printed instructions.
3. Repair concrete damage caused by construction activities, such as accidental equipment impact, temporary anchor bolts and construction equipment connections.
4. Repair all surface defects greater than 1/4 inch.
5. See Specification Section 03 35 00 - Concrete Finishing for concrete finishing requirements.
6. Prior to placement of repair material, surfaces must be saturated with clean water. Concrete substrate to be in a saturated, surface dry (SSD) condition with no standing water, minimum of four (4) hours prior to placing repair material. Bonding agents or scrub coats are be permitted based on the manufacturers requirements of the repair material.
7. Patching Mortar Aggregate: ASTM C33/C33M, washed clean, graded fine aggregate of suitable size for areas to be repaired. Clean coarse aggregate up to Size Number 8 are permitted be added for repair of larger pockets and voids.
8. Commerical Patching Mortar: Latex-modified cement mortar is permitted to be furnished if appropriate for the use.
9. Pre-Approved Repair Procedures do not substitute the requirements of Section 01 45 00 – Quality Control for non-conformity processes. Document defects in Non-Conformance Report (NCRs) and submit to the Resident Engineer for approval..

B. Site-Mixed Repair Materials:

1. Patching Mortar:
 - a. Use same materials as the concrete to be patched with no coarse aggregate. Do not use more than one part cement to 2-1/2 parts sand.
 - b. For repairs in exposed concrete, substitute white cement for a portion of the gray cement to produce a mix matching the surrounding concrete color when dry. Determine the proportion of white cement by trial mixes and test areas, prior to repair of actual defective areas.

C. Repair of Tie Holes:

1. Fill all tie holes, unless otherwise noted.
2. If cement patching mortar is used for plugging, clean and dampen tie holes before application.
3. At stations, form tie plugs must be used per Section 03 11 00 – Concrete Forming.

- D. Removal of surface stains and deposits.
 - 1. Remove stains, rust, efflorescence, and surface deposits considered objectionable by the Resident Engineer.

3.08 THERMAL CONTROL

- A. Limit concrete absolute maximum allowable internal temperature to 160 degrees Fahrenheit. Limit maximum differential temperature to 35 degrees Fahrenheit, between the middle of the placement and at a point 2 inches interior to the surface.
- B. Demonstrate that concrete temperatures do not exceed the specified limits:
 - 1. Test concrete temperatures in conformance with ASTM C1702.
 - 2. Record internal and surface temperatures:
 - a. Hourly until internal concrete temperature has dropped to less than 90 percent of the maximum recorded.
 - b. As necessary until trend indicates internal and surface concrete temperatures are converging.
 - 3. Provide chart recorder to document temperatures and submit records as part of Article 1.04, in this specification.

3.09 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory: Use an Independent Testing Laboratory to perform the following:
 - 1. Observe concrete batching and mixing operations.
 - 2. Record all concrete batched
 - 3. Record all concrete delivered to the project
 - 4. Collect and check concrete truck batch tickets
 - 5. Visually inspect concrete placement
 - 6. Sample and test concrete
 - 7. Obtain drilled cores of concrete, if required by the Resident Engineer
 - 8. Observe installation of temperature measurement devices in mass concrete, manage quality of recording process, and access and review electronic temperature data.
 - 9. Prepare reports on all inspection and test results
- B. Strip concrete formwork and inspect concrete quality prior to the next pour of the same element. Strip formwork for concrete when there is no next pour no later than one week after the required time period to ensure quality inspection in time.
- C. Provide additional labor, materials, or equipment required to assist the Independent Testing Laboratory in obtaining and handling samples at the site.

- D. Provide and maintain for the sole use of the Independent Testing Laboratory adequate facilities for safe storage and proper curing of concrete test specimens on site for initial curing.
- E. Confirm concrete curing time is maintained for required time.
- F. Concrete Sampling:
 - 1. Obtain composite samples in compliance with ASTM C172. Select the trucks or batches of concrete to be tested on a random basis. Obtaining samples at the truck is permitted if the Contractor determines the slump loss during pumping by comparing the slump at the truck with the slump at the end of the pumpline using the comparative test and the Contractor establishes the slump requirement at the truck based on the slump loss (See ACI 301 Optional Requirements Checklist Section 4.2.2.2).
 - 2. Obtain at least one composite sample for the first batch of concrete, and then for each 100 cubic yards, or fraction thereof, of each concrete mixture placed in any one day. When the total quantity of a given concrete mixture is less than 50 cubic yards, test the first batch of concrete, and at least one other batch.
 - 3. Determine slump of each sample in compliance with ASTM C143/ C143M.
 - 4. Determine air content of each sample in compliance with ASTM C231/ C231M.
 - 5. Determine temperature of each sample in compliance with ASTM C1064/ C1064M.
 - 6. Do not place concrete before slump, temperature, and air content tests demonstrate concrete is within acceptable limits.
 - 7. Conduct compressive strength tests of each sample in compliance with the following:
 - a. Mold and cure three cylinders in compliance with ASTM C31/ C31M. Record any deviations from the ASTM requirements in the test report. It is optional for the Contractor to make additional cylinders
 - b. Test cylinders in compliance with ASTM C39/ C39M. Test one specimen at seven days for information and two specimens at 28 days for acceptance, unless otherwise specified.
- G. Evaluation and Acceptance of Tests:
 - 1. Acceptance of Concrete:
 - a. The compressive strength tests results for acceptance of each sample shall be the average of the compressive strengths from the two specimens tested at 28 days.
 - b. If one specimen in a sample shows evidence of improper sampling, molding, or testing, discard the specimen and consider the strength of the remaining cylinder to be the test result.
 - c. If both specimens in a sample show any defects, both specimens must be discarded.
 - d. Compressive strength tests will be considered acceptable if the average compressive strength of all 28-day specimens of three consecutive sample tests are equal to or exceed the specified 28-day compressive strength,

and if no individual specimen compressive strength is more than 300 pounds per square inch below the specified 28-day compressive strength.

2. **Test Cores:** If concrete strength is not considered acceptable, or if there is a likelihood of low strength concrete, a significant reduction in load-carrying capacity or an absence of desired durability in the concrete, the Resident Engineer shall determine if test cores shall be drilled for determination of in-place strength:
 - a. Obtain and test specimens in conformance with ASTM C42. Take three cores from each area as directed by the Resident Engineer.
 - b. Test cores will be considered acceptable if the average of the three cores is equal to at least 85 percent of the specified 28-day compressive strength and no single core is less than 75 percent of the 28-day compressive strength. Locations represented by erratic core strengths are permitted to be retested at the direction of the Resident Engineer.
 - c. Perform rebar scanning when determining core locations..
 - d. Submit coring and core repair plan for the Resident Engineer's review and approval.
3. **Non-Conformance Report (NCR):** If concrete strength is not considered acceptable, or if there is a likelihood of low strength concrete, a significant reduction in load-carrying capacity or an absence of desired durability in the concrete, the Contractor must submit a Non-Conformance Report (NCR) to Resident Engineer for ST's review and approval including ST structural group. Submit the NCR as soon as possible if signs of low strength concrete are noticed after the formwork removal, and/or the seven day strength test is low.

END OF SECTION

SECTION 03 62 00
NON-SHRINK GROUTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for providing non-shrink grouts as indicated below.
 - a. Furnishing, mixing, and placing non-shrink, nonmetallic, noncorrosive cementitious grout.
 - b. Furnishing, mixing, and placing non-shrink, nonmetallic, noncorrosive epoxy grout.
 - c. Not applicable to Non-Shrink Grout for Post-Tensioning Applications.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. American Concrete Institute (ACI):
 - a. ACI 503.2- 503.4 Three Epoxy Specifications.
2. American Society for Testing and Materials International (ASTM):
 - a. ASTM C109/C109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. cube Specimens).
 - b. ASTM C157/C157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
 - c. ASTM C579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - d. ASTM C827/C827M Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
 - e. ASTM C881/C881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - f. ASTM C1090 Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout.
 - g. ASTM C1107/C1107M Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - h. ASTM D149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.

- i. ASTM D638 Standard Test Method for Tensile Properties of Plastics.
 - j. ASTM D5992 Standard Guide for Dynamic Testing of Vulcanized Rubber and Rubber-Like Materials Using Vibratory Methods.
- 3. United States Army Corps of Engineers (COE):
 - a. COE CRD-C620 Standard Method of Sampling Fresh Grout.
- 4. Washington State Department of Transportation (WSDOT).
 - a. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.
 - 1) Section 9-20.3(3) Grout Type 3 for Unconfined Applications.
 - 2) Section 9-26.3 Epoxy Grout/Mortar/Concrete.
- B. Definitions:
 - 1. Non-shrink grout: A mortar or grout that does not shrink in the plastic state, is dimensionally stable in the hardened state, and bonds permanently to a clean baseplate and concrete substrate.
- 1.03 SUBMITTALS
 - A. Transmit
 - 1. Product Data: Provide manufacturer's product data and installation instructions.
 - 2. Certification: Provide certificates of compliance or laboratory test reports that indicate the following:
 - a. Materials used in the grout are free from metallic components and corrosion-producing elements.
 - b. Materials meet specified shrinkage and compressive strength requirements.
- 1.04 DELIVERY, STORAGE, AND HANDLING:
 - A. Follow manufacturer's instructions for storage, handling, placing and curing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cementitious Grout: Provide non-shrink, nonmetallic, noncorrosive cement-based grout conforming to the following requirements:
 - 1. Applicable standard: ASTM C1107/C1107M.
 - 2. Expansion: 0.4 percent maximum at 3, 14, and 28 days. No displacement when tested in accordance with ASTM C157/C157M.
 - 3. Shrinkage at 28 days: none (0.00 shrinkage when tested in accordance with ASTM C827/C827M).

4. Compressive strength, as indicated on the Issued for Construction Drawings, and not less than:
 - a. At one day: 1000 pounds per square inch (psi).
 - b. At three days: 2500 psi.
 - c. At seven days: 3500 psi.
 - d. At 28 days: 5000 psi.
 5. Initial setting time, after addition of water: approximately one hour at 70 degrees Fahrenheit.
 6. Provide nonsag trowelability or flowability as necessary for the particular application.
- B. Water: Clean and potable, free of impurities detrimental to grout.
- C. Epoxy Grout: Provide nonshrink, nonmetallic, noncorrosive epoxy grout conforming to the following requirements:
1. Grout must be manufactured specifically for use in supporting heavy loads.
 2. Expansion: No displacement when tested in accordance with ASTM C827/C827M and ASTM C157/C157M, modified procedures.
 3. Shrinkage at 28 days: None (0.00 shrinkage when tested in accordance with ASTM C827/C827M modified procedure using a specific gravity of indicator ball of approximately 1.0) with a minimum effective bearing area (EBA) of 95 percent.
 4. Compressive strength, minimum: 10,000 psi at 7 days.
 5. Initial setting time: Approximately one hour at 70 degrees Fahrenheit.
 6. Provide flowable consistency as necessary for the particular application.
 7. Epoxy grouts which are volatile and which give off noxious fumes are not acceptable.
 8. Where aerial guideway bears on epoxy grout pads, provide manufacturer documentation that product will meeting the following performance standard.
 - a. At maximum depth, grout pad creep will not exceed 1/8 in. over 100 years.
- D. Epoxy Adhesive: ASTM C881/C881M, Type V, epoxy-based bonding agent.
- E. Elastomeric Grout:
1. Tensile Strength: ASTM D638.
 2. Dynamic Deflection: ASTM D5992.
 3. Dielectric Strength: ASTM D149.
- F. Unconfined non-shrink grout:
1. Meet the requirements of WSDOT Standard Specifications Section 9-20.3(3), Grout Type 3 for Unconfined Applications.

2.02 SOURCE QUALITY CONTROL

- A. Inspections and Tests: Perform visual inspections, and shrinkage tests using an approved independent test laboratory, and strength tests as necessary to verify performance requirements of grout. Sample and test grout in conformance with applicable ASTM or COE CRD-620 requirements.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare concrete surfaces to receive grout by chipping, sandblasting, water blasting, or other accepted methods specified by the manufacturer to remove defective concrete, laitance, dirt, oil, grease, and other foreign matter to achieve sound, clean, and roughened concrete surfaces, in accordance with the manufacturer's requirements.
- B. Cover concrete areas with protective waterproof covering until ready to place grout.
- C. Remove foreign matter from surfaces to be in contact with grout. Clean contact steel surfaces as necessary by wire brushing and wiping dust clean.
- D. Align and level components to be grouted, and maintain in final position until grout placement is complete and accepted.
- E. Install forms for grout about the columns and other spaces to be grouted.
- F. Remove protective waterproof covering and clean contaminated surfaces immediately before grouting.
- G. Provide air-relief holes in large baseplates and in baseplates where underneath obstructions cause air entrapment.
- H. Saturate concrete surfaces with clean water, and remove excess water immediately before grouting.
- I. Where necessary or appropriate for better bond, epoxy adhesive is permitted to clean, dry substrate surfaces in accordance with applicable requirements of ACI 503.2-503.4.

3.02 INSTALLATION

- A. Mixing:
 - 1. Mix grout ingredients in accordance with the respective manufacturer's instructions. Mix grout materials in proper mechanical mixers.
 - 2. Mix grout as close to work area as possible.
- B. Installation:
 - 1. Place grout in accordance with the manufacturer's published instructions. Pour grout from one side only until grout rises at least one inch above the plate on opposite side of said plate. Strapping and plunging or other methods are permitted to be used to force grout to flow under the entire area.
- C. Place Grout Type 3 for Unconfined Applications in accordance with requirements of WSDOT Standard Specifications Section 9-20.3(3).
- D. Neatly trowel edges of grout base, tapered at an angle of 60 degrees when measured from the horizontal, or as indicated.

1. Do not remove leveling shims for at least 48 hours after grout has been placed.
2. After shims have been removed, if used, fill voids with grout, packing the material with a suitable tool.
3. Do not use grout that has begun to set or if more than one hour has elapsed after initial mixing.

3.03 CURING

- A. Cure cementitious grout as specified by the grout manufacturer.
- B. Cure epoxy grout as specified by the grout manufacturer.

END OF SECTION

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SECTION 05 05 23
METAL FASTENINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for welding and bolting of structural steel and metal fabrications, and welding of sheet steel.
2. Requirements for welders, welding procedures, and inspections and tests of welding and bolting.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. American Institute of Steel Construction (AISC):
 - a. AISC 303 Code of Standard Practice for Steel Buildings and Bridges.
2. American Society for Nondestructive Testing (ASNT).
3. Recommended Practice Number SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing.
4. ASTM International (ASTM):
 - a. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - b. ASTM A153/A153M Standard Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
 - d. ASTM F3125 / F3125M Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength.
 - e. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.
 - f. ASTM E94 / E94M Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
 - g. ASTM E164 Standard Practice for Contact Ultrasonic Testing of Weldments.
 - h. ASTM E165 Standard Practice for Liquid Penetrant Testing for General Industry.
 - i. ASTM E709 Standard Guide for Magnetic Particle Testing.

- j. ASTM E1032 Standard Practice for Radiographic Examination of Weldments Using Industrial X-Ray Film.
 - k. ASTM F436 / F436M Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 - l. ASTM F844 Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
 - m. ASTM F959 / F959M Standard Specification for Compressible-Washer- Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.
- 5. ASTM F3125 / F3125M Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength American Welding Society (AWS):
 - a. ANSI/AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. ANSI/AWS A3.0 Standard Welding Terms and Definitions.
 - c. ANSI/AWS B1.10 Guide for the Nondestructive Examination of Welds.
 - d. ANSI/AWS D1.1/D1.1M Structural Welding Code – Steel.
 - e. ANSI/AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
 - f. ANSI/AWS D1.5M/D1.5 Bridge Welding Code.
 - g. ANSI/AWS D1.6/D1.6M Structural Welding Code – Stainless Steel.
 - h. ANSI/AWS D1.8/D1.8M Structural Welding Code – Seismic Supplement.
 - i. AWS QC1 Specification for AWS Certification of Welding Inspectors.
- 6. Research Council on Structural Connections(RCSC):
 - a. Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- 7. Washington Association of Building Officials (WABO):
 - a. WABO Welder and Welding Operator Performance Qualification Standard (No. 27-13).
- 8. Washington Department of Transportation(WSDOT):
 - a. WSDOT Standard Specifications for Road, Bridge and Municipal Construction.
- B. Definitions:
 - 1. Welds: Welding terms and definitions are per ANSI/AWS A3.0. Welding symbols are per ANSI/AWS A2.4.
 - 2. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, that support design loads.

3. Seismic Load Resisting System (SLRS): Assembly of Structural Steel elements that resist seismic loads. Members of SLRS are indicated in the Issued for Construction Drawings.
4. Seismic Demand-Critical Welds: Welds in the SLRS including:
 - a. Complete penetration welds in beam-to-column connections, including welds to flanges, webs, and flange reinforcement, stiffener, and doubler plates.
 - b. Complete penetration welds of column splices and of columns to base plates.
 - c. Fillet welds connecting braced frame gusset plates to braces, beams, and columns.
 - d. Other welds indicated as "Seismic Demand Critical" on the Issued for Construction Drawings.
5. Protected Zones: Area of a member in which limitations apply to fabrication and attachments. See Part 3 – EXECUTION of this Section.
6. Lowest Anticipated Service Temperature: 0 degrees Fahrenheit, as required by ANSI/AWS D1.8/D1.8M.

1.03 SUBMITTALS

A. Submit:

1. Shop Drawings: In compliance with AWS A2.4 and AWS A3.0.
 - a. Welding Inspector Qualifications per Article 1.04 Quality Assurance.
 - b. Personnel Performing Nondestructive Testing Qualifications per Article 1.04 Quality Assurance.
 - c. Stud-Connector Manufacturer per Article 1.04 Quality Assurance.

B. Transmit:

1. Manufactured Products:
 - a. Welding Electrode: Manufacturer's certification of conformance.
 - b. High-Strength Bolts, Nuts, and Washers: Manufacturer's mill certificates demonstrating conformance.
 - c. Mild Bolts, Nuts, and Washers: Manufacturer's mill certificates demonstrating conformance.
 - d. Direct Tension Indicating Washers: Manufacturer's mill certificates demonstrating conformance, if proposed for use.
 - e. Tension Control Structural Bolt-Nut-Washer Assemblies: Manufacturer's mill certificates demonstrating conformance, if proposed for use.
2. Qualifications:
 - a. AWS or WABO certified welders:
 - 1) Transmit certified copies of qualification test records for each welder, welding operator, and tack welder to be employed in the work.

Transmit welders' identification marks (ID) for each welder along with qualifications.

3. Welding Procedures:
 - a. Prior to commencement of welding, submit the procedure to be used for qualifying welding procedures.
 - b. For procedures other than those pre-qualified in accordance with AWS D1.1/D1.1M Structural Welding Code - Steel, submit a copy of procedure qualification test records in accordance with the qualification requirements of AWS D1.1/D1.1M, Section 4, Parts A and B.
4. Welding Records and Data: For field welding, transmit descriptive data for field welding test results and equipment used.
5. Mill Certificates: Retain mill certificates and certified copy of reports for all analyses and tests required by referenced AWS specifications.
6. Inspection and Test Reports: Forward inspection and test results to the Resident Engineer immediately after results are available. Results to state whether results are conforming or nonconforming.
 - a. Visual inspection reports.
 - b. Nondestructive test reports.

1.04 QUALITY ASSURANCE

- A. Qualifications of Welders, Welding operators, and Tack welders: In accordance with AWS D1.1/D1.1M, Section 4, "Qualification", and ICC/WABO Certified.
- B. Qualification of Welding Procedures: Prequalified or qualified in accordance with AWS D1.1/D1.1M, Section 4, "Qualification".
- C. Qualifications of Welding Inspector: Contractor-employed AWS Certified Welding Inspector (CWI), certified in accordance with AWS QC1, and ICC/WABO Certified.
- D. Qualification of Personnel Performing Nondestructive Testing (NDT):
 1. American Society for Nondestructive Testing Certified (ASNT SNT-TC-1A).
 2. Only persons certified for NDT Level I and working under an NDT Level II person or persons certified for NDT Level II are permitted perform nondestructive testing.
- E. Weldability of Steel: For structural steel requiring impact test qualification, establish the weldability of the steel and the procedures for welding by qualification in accordance with AWS D1.1/D1.1M, Section 4, to match the notch toughness and weathering characteristics of the base metal.
- F. Qualification of Stud-Connector Manufacturer: In accordance with ANSI/AWS D1.1/D1.1M, Annex IX, "Manufacturers' Stud Base Qualification Requirements. ICC/WABO structural steel building certified inspector for all high strength bolting.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle welding electrodes in conformance with ANSI/AWS D1.1/D1.1M.
- B. Deliver, store, and handle bolts, nuts, and washers in conformance with RCSC Specification.

1.06 BRIDGE AND PEDESTRIAN BRIDGE STEEL FASTENINGS

- A. For steel bridges, steel pedestrian bridges, and fastenings of all steel components, refer to WSDOT Standard Specifications in lieu of the requirements in this section.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Welding Rod/Electrodes for structural plate, shapes and bars:
1. Conform to AWS A5 Series Standards.
 2. Use coated rods or wire of size and classification number as specified by their manufacturers for the positions and other conditions of actual use. Match filler metal in conformance with AWS D1.1/D1.1M, Table 3.1 or 3.2 consistent with design requirements.

2.02 MATERIALS

- A. Fasteners:
1. High Strength Bolts:
 - a. Bolt: ASTM F3125 /F3125M.
 - b. Nuts: ASTM A563 heavy-hex.
 - c. Washers: ASTM F436.
 - d. Finish: Hot-dipped zinc coating per ASTM A153/A153M. Bolting conforming to ASTM F3125 Grade A490 must not be galvanized.
 2. Tension Control Structural Bolt-Nut-Washer Assemblies:
 - a. Bolts: ASTM F3125 Grade F1852, Type 1, heavy hex or dome head, splined ends.
 - b. Nuts: ASTM A563 heavy hex.
 - c. Washers: ASTM F436.
 - d. Finish: Hot-dip zinc coat in conformance with ASTM A153/A153M, Class
 - e. Bolting conforming to ASTM F3125 Grade A490 must not be galvanized.
 3. Mild Bolts: Provide mild bolts, where noted A307:
 - a. Bolts: ASTM A307, Type A.
 - b. Nuts: ASTM A563A hex.
 - c. Washers: ASTM F844.
 - d. Finish: Hot-dipped zinc coat in conformance with ASTM A153/A153M, Class C.
 4. Anchor Bolts: Section 03 15 25 - Anchorage to Concrete.

5. Welded Shear Connectors and Welded Headed Studs: ASTM A108, grades 1010 through 1020, headed stud type, cold finished carbon steel, AWS D1.1/D1.1M, Type B.

B. Welding Electrodes for Structural Shapes, Plates, and Bars:

1. Conform to ANSI/AWS A5 Series Standards, with a minimum tensile strength of 70 ksi. Provide coated rods or wire of size and classification number as specified by the manufacturer for the positions and other conditions of actual use. Match filler metal requirements in conformance with ANSI/AWS D1.1/D1.1M.

2.03 FABRICATION

- A. Unless specifically noted as field-welded, welds are permitted to be shop or field welded at the Contractor's option. Perform shop welds in a WABO certified shop.

- B. Welding of reinforcing steel for concrete: Conform to concrete reinforcing requirements as stated in the Issued for Construction Documents.

C. Shop Welding:

1. Perform shop welding as indicated in accordance with ANSI/AWS D1.1/D1.1M, AWS D1.5M/D1.5, ANSI/AWS D1.6/D1.6M, AWS D1.8/D1.8M, and ANSI/AWS D1.3/D1.3M, as applicable to the work.
2. Weld joints in conformance with approved AWS. Make ANSI/AWS D1.1/D1.1M available to welders and inspectors during fabrication.
3. Provide complete joint penetration welds for groove welds indicated on the Issued for Construction Drawings unless noted otherwise. Select groove preparation in conformance with ANSI/AWS D1.1/D1.1M.
4. Remove backing bars for complete joint penetration welds where indicated in the Issued for Construction Drawings or required for testing and inspection.
5. Mark welder ID adjacent to completed weld using metal stamp, metal engraving, keel, paint stick, or other appropriate marking material.
6. Weld stud shear connectors in conformance with stud manufacturer's printed instructions.

- D. Anchorage to concrete: As stated in the Issued for Construction Documents.

E. Shop Bolting:

1. Drive bolts accurately into holes without damaging the thread. Protect bolt heads from damage during driving. Place washers and all bolt heads and nuts. Rest bolt heads and nuts squarely against the washers:
 - a. High-Strength Bolting Assemble joints in conformance with RCSC Specification.
 - b. Pretension bolts unless noted otherwise.
 - c. Pre-tensioned bolted connection qualification testing per RCSC must be performed.
 - d. Prepare faying surfaces for joints indicated as Slip-Critical in conformance with Class C for galvanized items, and in conformance with Class A for non-galvanized items.

- e. Snug-tight connections are permitted in beam-to-beam connections only if specified on the plans or approved by an Engineer with the appropriate authority.

2.04 SHOP WELD QUALITY CONTROL

- A. Shop Welding Procedures and Personnel: Verify the following prior to and during fabrication:
 - 1. Welder qualifications and identifications.
 - 2. Welding Procedures Specification (WPS) has been provided to and reviewed with each welder performing the Work.
 - 3. Consumables meet WPS requirements.
 - 4. Joint fit-up meets WPS requirements. Mark joint prior to welding.
 - 5. Preheat and interpass temperatures and weld pass sequence meet WPS requirements.
- B. Shop Welding Inspections and Testing:
 - 1. Visual Inspection: ANSI/AWS D1.1/D1.1M. Visually inspect 100 percent of welds, for both permanent and temporary Work.
 - 2. Ultrasonic Testing: ANSI/AWS D1.1/D1.1M, Chapter N of AISC 360-10 or the corresponding chapter in the latest edition, and ASTM E164, as applicable. Ultrasonically test complete joint penetration groove welds as follows:
 - a. 10 percent with material thickness equal to or less than 3/4 inch.
 - b. 50 percent with material thickness greater than 3/4 inch and equal to or less than 1-1/2 inches.
 - c. 100 percent for material thickness greater than 1-1/2 inches.
 - 3. Magnetic Particle Inspection: ASTM E709, Chapter N of AISC 360-10 or the corresponding chapter in the latest edition. Inspect complete and partial joint penetration groove welds and fillet welds as follows:
 - a. 20 percent of complete joint penetration groove welds of tee and corner joints.
 - b. 10 percent of partial joint penetration groove welds and fillet welds.
 - 4. Liquid Penetrant Inspection: ASTM E165/E165M. Liquid penetrant inspection may be used for detecting discontinuities that are open to the surface.
 - 5. Radiographic Testing: ANSI/AWS D1.1/D1.1M, ASTM E94, and ASTM E1032, as applicable.
 - 6. Nondestructive Testing:
 - a. In accordance with ANSI/AWS B1.10.
 - b. For Permanent and Temporary Work: in accordance with WSDOT Standard Specifications Section 6-03.3(25)A.
 - 7. Quality of welds and standards of acceptance: In accordance with AWS D1.1/D1.1M, Sections 5, 6, and 7, as applicable.

8. Test Results: Submit test result information to the Resident Engineer immediately after test results are available, stating the acceptance or rejection of fabricated components, so that repairs and re-inspection or testing may be performed as soon as possible.
- C. Shop Bolting Inspection and Testing:
1. Torque Wrench Calibration:
 - a. Calibrate torque wrenches in conformance with RCSC Specification.
 - b. Test the calibrating device for setting calibrated torque wrenches for accuracy using qualified personnel not more than 30 days prior to first use on the Work, and at intervals not more than six (6) months thereafter.
 - c. If the Resident Engineer finds the accuracy of the calibrating device inadequate, the Contractor must return it to the manufacturer for certification of accuracy.
- D. Shop Inspections and Tests:
1. Independent verification inspection and testing at the shop must conform to requirements in Section 01 45 00 - Quality Assurance / Quality Control.
 2. All welds and bolted connections are subject to inspections and testing for conformance to requirements in Section 01 45 00 - Quality Assurance / Quality Control.

PART 3 - EXECUTION

3.01 ERECTION

- A. Field Bolting: Perform field bolting as specified for shop bolting.
- B. Connections at Protected Zones:
1. Protected Zones are as indicated on the Issued for Construction Drawings.
 2. Within protected zones, repair discontinuities created by fabrication or erection operations, such as tack welds, erection aids, air-arc gouging, and thermal cutting as required by the Issued-for-Construction Drawings and/or Resident Engineer.
 3. Welded shear studs and decking attachments that penetrate the beam flange must not be placed on beam flanges within the Protected Zones. Decking arc spot welds as required to secure decking shall be permitted.
 4. Welded, bolted, screwed or shot-in attachments for perimeter edge angles, exterior facades, partitions, duct work, piping or other construction must not be placed within the Protected Zone.

3.02 FIELD QUALITY CONTROL

- A. All quality control measures in this specification must conform to requirements in Section 01 45 00 - Quality Assurance / Quality Control.
- B. Field Welding Procedures and Personnel: Verify field welding procedures and personnel prior to and during field welding as specified for shop welding procedures and personnel.

- C. Field Welding Inspection and Testing: Perform field welding inspection and testing as specified for shop welding inspection and testing.
- D. Field Bolting Inspection and Testing: Perform field bolting inspection and testing as specified for shop bolting inspection and testing.
- E. Verify all tests and inspections demonstrate conformance with the Issued for Construction Documents before loading structures, either temporary or permanent and submit results to the Resident Engineer.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for furnishing, fabricating, and erecting structural steel for building structures. Steel requirements for bridges are not included.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. American Institute of Steel Construction (AISC):
 - a. AISC 303 Code of Standard Practice for Steel Buildings and Bridges.
 - b. AISC 341 Seismic Provisions for Structural Steel Buildings.
 - c. AISC 358 Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications, including Supplement No. 1.
 - d. AISC 360 Specification for Structural Steel Buildings.
2. ASTM International (ASTM):
 - a. ASTM A6/A6M Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - b. ASTM A36/A36M Standard Specification for Carbon Structural Steel.
 - c. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - d. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - e. ASTM A252 Standard Specification for Welded and Seamless Steel Pipe Piles.
 - f. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
 - g. ASTM A435/A435M Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
 - h. ASTM A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - i. ASTM A529/A529M Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
 - j. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.

- k. ASTM A572/A572M Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - l. ASTM A588 Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance.
 - m. ASTM A992/A922M Standard Specification for Structural Steel Shapes.
 - n. ASTM F436 / F436M Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 - o. ASTM F959 / F959M Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.
 - p. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 - q. ASTM F3125 / F3125M Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- 3. American Welding Society (AWS):
 - a. ANSI/AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. ANSI/AWS D1.1/D1.1M Structural Welding Code – Steel.
 - c. AWS D1.8 Structural Welding Code – Seismic Supplement.
- 4. Research Council on Structural Connections (RCSC):
 - a. Specification for Structural Joints Using High-Strength Bolts.
- 5. The Society for Protective Coatings (SSPC):
 - a. SSPC SP 6 Commercial Blast Cleaning.
- 6. Washington Department of Transportation (WSDOT):
 - a. WSDOT Standard Specifications for Road, Bridge and Municipal Construction.
- 7. American Petroleum Institute (API):
 - a. API Specification 5L.
- B. Definitions:
 - 1. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, that support design loads.
 - 2. Seismic Load Resisting System (SLRS): Assembly of Structural Steel elements that resists seismic loads. Members of SLRS are indicated in the Issued for Construction Drawings.
 - 3. Demand-Critical Welds: Welds in the SLRS including:

- a. Complete penetration welds in beam-to-column connections, including welds to flanges, webs, and flange reinforcement, stiffener, and doubler plates.
 - b. Complete penetration welds of column splices and of columns to base plates.
 - c. Fillet welds connecting braced frame gusset plates to braces, beams, and columns.
 - d. Other welds indicated as "Seismic Demand Critical" on the Issued for Construction Drawings.
4. Protected Zone: See Issued for Construction Drawings for members or parts of members defined as Protected Zones, and surface of braced frame diagonal member, its gusset plates and cover plates in which restrictions apply to fabrication and attachments. Protected zones are noted on the Issued for Construction Drawings.

1.03 SUBMITTALS

A. Submit:

- 1. Shop Drawings:
 - a. Submit detailed shop drawings of structural steel work, including erection plans and piece drawings, showing member sizes, details of fabrication and construction, methods of assembly, field welding, spacing and locations of members, hardware, anchors, openings, weep holes and locations, and accessories, and erection sequence and details. Include procedures for heavy lifts and rigging.
 - b. Welding Procedures: Submit welding procedures and overall fabrication methods in conformance with AWS D1.1/D1.1M and AWS D1.8.
 - c. Include in shop drawings member identity, welding technique, cuts, copes, gussets, connections, holes, fasteners, camber, fabrication and erection tolerances, type of finish, paint system, weights of members, and critical clearances. Indicate locations of Protected Zones.
 - d. Indicate welds, both shop and field, using standard welding symbols of ANSI/AWS A2.4. Show the size, length, and type of each weld on drawings. Identify welds to the SLRS and Demand Critical Welds.
 - e. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - f. Verify all dimensions and coordinate with adjoining work.
 - g. Indicate individual welders' identification (ID) on record documents.
 - h. All shop drawings must be reviewed by and coordinated for handholes with the corresponding subcontractors.
- 2. Template Drawings and Placement Plans: As required for satisfactory placing of connections and anchorages.

3. Working Drawings and Method Statements:
 - a. Investigate stresses caused by the proposed erection procedure.
 - b. Submit the construction sequence for erection and disassembly of the shoring system. Indicate how sequence is coordinated with interim grading and drainage and the construction of the permanent structure.
 - c. Submit drawings sealed by a Professional Engineer registered in the State of Washington. Show details of required temporary supports, staying, and bracing. Include descriptive data to illustrate the erection, transportation, and handling procedures, including sequence of erecting and transfer of loads if applicable.
 - d. Submit calculations sealed by a Professional Engineer registered in the State of Washington supporting the drawings and other descriptive data.
 - e. Furnish setting diagrams, templates, and directions for the erection of structural framing, anchor bolts, bearing plates, and other embedded items.
4. Shop testing report as required in Article 1.05 Quality Assurance, in this specification.
5. Welding Records and Data: Refer to Section 05 05 23 Metal Fastenings for the requirements as stated in the Issued for Construction Documents.

B. Transmit:

1. Product Data:
 - a. Manufacturer's product data for load-indicator washers (Compressible washer-type direction tension indicators), bolts and accessories.
 - b. Data on coating system. Steel shop primer and intermediate and finish high performance coatings must be compatible between each other.
2. Certificates:
 - a. At completion of fabrication, the approved fabricator must transmit a Certificate of Compliance and copy to the Building Official stating that the work was performed in accordance with the approved construction documents.
3. Mill test reports of structural steel materials, showing:
 - a. Name, address and phone number of the steel manufacturer.
 - b. Statement identifying the type of steel referenced on the mill certification (for example: carbon plate, ASTM A36/A36M/ASME SA36).
 - c. Statement that the steel was melted and rolled in the USA.
 - d. Number of pieces represented by the mill certification (for example: 6 pieces, 12 feet by 12 feet by 6 inches).
 - e. Physical properties including Heat Number, Yield Strength, Tensile Strength, Percentage of Elongation, Hardness (if applicable) and Bend Tests (if applicable).

- f. Chemical Analysis as applicable for each type of steel and each heat number referenced on the mill certification including Carbon, Manganese, Phosphorus, Sulfur, Silicon, Copper, Nickel, Vanadium, Columbium, Aluminum, Chromium, Molybdenum, and Cerium.
 - g. Signature of the person that prepared the mill certificate.
 - 4. Qualifications:
 - a. Fabricator: AISC certification and current work history.
 - b. Erector: AISC certification and current work history.
 - c. Professional Engineer: License number and current work history.
 - 5. Calibration Records:
 - a. Provide copies of torque wrench calibration records.

1.04 QUALITY ASSURANCE

- A. Fabricator:
 - 1. Currently certified under the AISC Certification Program, Category BU.
 - 2. Minimum of five (5) years of experience with successfully completed structural steel work of similar complexity.
- B. Erector:
 - 1. Minimum of five (5) years of experience with successfully completed structural steel work of similar complexity.
- C. Professional Engineer: Licensed professional engineer currently registered in the State of Washington.
- D. Certifications of Welders: Refer to Section 05 05 23 - Metal Fastenings for the requirements.
- E. Shop Testing by Contractor: Perform ultrasonic testing and visual inspection of all plate material and rolled sections greater than 1-1/2 inches in thickness and located at welded connections for discontinuities prior to fabrication. The test area is defined as a zone up to 6 inches away from the weld in the connection. These tests are in addition to the ultrasonic testing of all full-penetration welds to be performed by the Owner's Testing Agency. Submit the testing report to the Resident Engineer. All costs associated with this testing are borne by the Contractor:
 - 1. Ultrasonic Testing: Conduct in accordance with ASTM A435 with the following modifications and supplementary requirements:
 - a. Supplementary Requirements S1, including 100 percent scanning of the test.
- F. Certifications of Welding Procedures: Refer to Section 05 05 23 - Metal Fastenings for the requirements.
- G. Pre-Construction Conference: Schedule a job conference to review the Structural Documents prior to development of shop drawings. The conference must be attended by all pertinent parties, which is, at a minimum, to include the Fabricator, Erector, Contractor, Owner's Testing Agency, and Structural Engineer.

1.05 DELIVERY STORAGE AND HANDLING

- A. Load, transport, unload, and store structural steel materials in such a manner that the metal is kept clean and free from injury. Store materials above ground on platforms, skids, or other supports, and cover and protect from corrosion.
- B. Mark weight and piece (mark) number, corresponding to shop erection sequence drawing, on all members. Match-mark all shop pre-fitted members.
- C. Ship small parts, such as bolts, nuts, washers, pins, fillers, clips, and small connecting plates and anchors, in boxes, crates, or barrels, plainly mark with an itemized description of the contents on the outside of each container.
- D. Pack separately each length and diameter of bolt and each size of nut and washer.
- E. Avoid bending, scraping, and overstressing the steelwork. Block with wood, or otherwise protect, projecting parts that may be bent or damaged.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Wide Flange Shapes:
 - 1. ASTM A992/A992M Gr. 50.
 - 2. AASHTO M270 Gr. 50.
- B. HP Shapes: ASTM A572 Gr. 50.
- C. Channels and MC shapes: ASTM A36/A36M.
- D. Angles: ASTM A36/A36M.
- E. Plate:
 - 1. ASTM A36/A36M.
 - 2. ASTM A572/A572M, Grade 50.
 - 3. ASTM A529/A529M, Grade 50.
 - 4. AASHTO M270 Gr. 50.
- F. Hollow Structural Sections:
 - 1. Rectangular: ASTM A500 / A500M, Grade C.
 - 2. Round, diameter equal to or less than 20 inches: ASTM A500 / A500M, Grade C or B.
- G. Pipe, diameter equal to or less than 12 inches: ASTM A53 / A53M, Grade B, Fy = 35 ksi.
- H. HP shapes: ASTM A572 Gr. 50.
- I. S shapes: ASTM A36.

2.02 PRODUCTS

- A. Bolts: Refer to Section 05 05 23 - Metal Fastenings as stated in the Issued for Construction Documents.

- B. Welding Electrodes: Conform to Section 05 05 23 Metal Fastenings as stated in the Issued for Construction Documents.
- C. Unheaded anchor rods: ASTM F1554, Grade 55 unless otherwise noted on structural drawings. Finish: Plain
- D. Headed anchor rods: ASTM F1554, Grade 55 unless otherwise noted on structural drawings. Finish: Plain
- E. Threaded Rods: ASTM A36/A36M or ASTM F1554, Grade 55, as noted on structural drawings.
- F. Shear connectors: ASTM A108, Grades 1015 through 1020, headed stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- G. Fasteners: Conform to Section 05 05 23 - Metal Fastenings as stated in the Issued for Construction Documents.
- H. Base Plate Shims:
 - 1. Grouted Base Plates; Provide MB SUPER SHIMS manufactured by Meadow Burke, stainless steel shims, or approved equal.
 - 2. Non-Grouted Base Plates; Stainless steel shims.

2.02 FABRICATION

- A. Protected Zones: Do not connect to members and parts of members defined as Protected Zones in the Drawings in the protected zones and do not modify or damage as indicated below. Protected Zones occur at braced frames and members or parts of members as indicated on the Issued for Construction Drawings. Within the protected zones, the fabrication and erection must prevent the following:
 - 1. Do not create discontinuities by fabrication or erection operations, such as tack welds, erection aids, air-arc gouging, and thermal cutting.
 - 2. Do not place welded shear studs and decking attachments that penetrate the beam flange on beam flanges within the protected zone. Decking arc spot welds as required to secure decking are permitted.
 - 3. Do not place welded, bolted, screwed or shot-in attachments for perimeter edge angles, exterior facades, partitions, duct work, piping or other construction within the protected zones.
- B. Conform to the applicable requirements of AISC 360, AISC 341 and AISC 303.
- C. Conform to Section 05 05 23 - Metal Fastenings stated in the Issued for Construction Documents.
- D. Fabricate elements of the SLRS in accordance with AISC 341 and AISC 358, including supplement 1, for special and intermediate steel moment frames.
- E. Prefabricate and preassemble steel members and metal fabrications in the factory or shop as far as practicable. Mark and match-mark materials for field assembly.
- F. Form and fabricate the work to meet installation conditions. Include accessories to adequately secure the work in place. Be responsible for errors of fabrication and for correct fitting of structural members.

- G. Center all electrical, system and mechanical handholes on the centerline of the member webs. Round all corners for handholes (radius of 2 times the web thickness).
- H. Seal joined members exposed to weather by continuous welds. Grind exposed welds smooth.
- I. Straighten rolled material, if necessary, before laying it out for fabrication, in a manner conforming to the mill tolerances specified in ASTM A6/A6M, and by a process and in a manner which does injure the material. Sharp kinks and bends are cause for material rejection. Do not use heat shrunk low-alloy structural steel.
- J. Perform shearing, flame cutting, and chipping carefully and accurately so as not to induce residual stress in the metal being cut. Hold the radii of re-entrant gas-cut fillets not less than $\frac{3}{4}$ -inch and as much larger as practicable. For cut edges exposed in the finished work, machine cut, shear, or flame cut, and grind flush in conformance with AISC 360. Maintain all working points.
- K. Maintain all working points.
- L. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water accumulates. Provide 1/4-inch diameter weep holes (flame cut holes are prohibited) at the low points of all vertical and diagonal HSS, pipe and tube members; at the bottoms of all horizontal HSS, pipe and tube members (minimum 2 per members).
- M. Fabricate bearing stiffeners and stiffeners intended as supports for concentrated loads as indicated. Mill or grind bearing surfaces of these stiffeners.
- N. Bend load-carrying cold-rolled steel plates cold at right angles to the direction of rolling. Bend such that the radius of bend, measured to the concave face of the metal, is not less than indicated in the following table, in which T is the thickness of the plate.

ANGLE THROUGH WHICH PLATE IS BENT	MINIMUM RADIUS
61 to 120 degrees	1.0 T
121 to 150 degrees	2.0 T

- 1. If a shorter radius is indicated, bend the plate hot. Before bending, round plate edges where bending occurs to a radius of 1/16-inch.
- O. Bolt or weld connections as indicated on the Issued for Construction Drawings.
- P. At Station Entrances, Systems Raceways, Interior Soffit Framing and any Structural Steel Framing within 20 feet of public walking surfaces, do not use screws or bolts wherever welding can be performed at connections. When using bolts connections if unavoidable, countersink heads and draw up tight; nick threads to prevent loosening.
- Q. At Station Entrances, Systems Raceways, Interior Soffit Framing and any Structural Steel Framing within 20 feet of public walking surfaces, minimize Weld Show-Through where exposed to view through use of intermittent welds, selection of weld type (i.e., gas shield instead of arc), and heat dissipation techniques employed in the fabrication and assembly process.
- R. Visible welds at Station Entrances, Systems Raceways, Interior Soffit Framing and any Structural Steel Framing within 20 feet of public walking surfaces: Grind flush and smooth all welds that are exposed to view at Station Entrances and meet the requirements in AWS D1.1/D1.1M, also do not project all groove and plug welds that are exposed to view more

than 1/16-inch above the exposed surface and remove weld spatter at all surfaces exposed to view. In addition:

1. Make exposed joint butt tight, flush, and hairline. Ease exposed sheared edges to a radius of approximately 1/32-inch, unless otherwise indicated.
 2. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 3. Seal continuous welds to close any open gaps.
 4. Close all weld access holes at full penetration welds.
 5. Unless otherwise indicated on the Issued for Construction drawings, weld all shop connections.
 6. Grind smooth tack welds, and fill holes with weld metal and smoothed by grinding or filing.
- S. Drill or punch holes at right angles to the surface of the metal. Do not flame cut holes or enlarge holes by burning. Drill holes in base or bearing plates. Provide holes in members to permit connecting the work of other trades. Punch or drill holes at 1/16-inch larger than the diameter of the bolt.
- T. For high-strength bolting, assemble joints in conformance with RCSC Specification for Structural Joints and install bolts in accordance with AISC Specification for Structural Joints Using F3125/F3125M Bolts and ASTM A563 heavy hex nuts. Use hardened-face washers in conformance with ASTM F436 for all connections using F3125/F3125M bolts. Assemble joints using load-indicator washers in conformance with ASTM F959.
- U. For items bearing on concrete, provide steel bearing plates and anchors. Level base or bearing plates by means of adjustment nuts and washers or permanent shims that are promptly grouted after the structural steel has been plumbed. Furnish templates, together with instructions for setting of anchors, anchor bolts, and bearing plates. Set anchors and related items properly in concrete during the progress of the work.
- V. Fabricate metal bearing surfaces that contact preformed elastomeric bearing pads or grout flat to within 1/8-inch tolerance in 12 inches and to within 3/16-inch overall.
- W. Include reinforcing angles, clip angles, plates, punched straps, brackets, and hangers as required to complete the work as indicated.
- X. Provide drainage holes in structural components to prevent water accumulation.
- Y. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Finish surfaces of members exposed in the final structure must be free of markings, burrs, and other defects.
- Z. Repair discontinuities within Protected Zones caused by fabrication operations such as tack welds, erection aids, air-arc gouging, and thermal cutting in conformance with AWS D1.8.
- AA. Do not leave erection marks or other painted marks on those surfaces of weathering steel members that are to be exposed in the completed structure. Unless otherwise specified in the Issued for Construction Documents, clean weathering steel members to meet the requirements of SSPC SP 6.
- BB. At Station Entrances, Systems Raceways, Station Canopies, Egress Stairs, and Interior Soffit Framing and any Structural Steel Framing within 16 feet of public walking surfaces, fill, ground or remove stamped or raised manufacturer's identification marks.

- CC. Seams of hollow structural sections is permitted as produced. Orient seams away from view or as directed in the Issued for Construction Documents.
- DD. Welded Headed Stud Shear Connectors: Prepare steel surfaces as specified by manufacturer of shear connectors. Use automatic end welding of heads stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.03 FINISHES

- A. Refer to 'Issued for Construction Documents' for finish types and Section 05 05 23 - Metal Fastenings and 09 96 00- High Performance Coatings for requirements.

2.04 WELDING

- A. Shop Welding and Shop Welding Repairs: Refer to Section 05 05 23 - Metal Fastenings for welding requirements.

2.05 BOLTING

- A. Shop Bolting: Refer to Section 05 05 23 - Metal Fastenings for shop bolting requirements.

2.06 SOURCE QUALITY CONTROL

- A. Fabricator's Facility
 - 1. Select a Fabricator certified by AISC.
 - 2. Provide the Resident Engineer access to inspect the AISC-Certified Fabricator's shop or facility before the start of fabrication work. Notify the Resident Engineer in writing at least 10 days before the scheduled start of fabrication work.
- B. Calibration of Torque Wrenches:
 - 1. Check the calibrating device for setting calibrated torque wrenches for accuracy using qualified personnel not more than 30 days prior to its first use on the work, and at intervals not more than 6 months thereafter.
 - 2. Provide copies of calibration records to the Resident Engineer. Calibrate torque wrenches as specified in the RCSC Specification for Structural Joints using F3125/F3125M Bolts.
- C. Issue Non-Conformance Report (NCR) for deficiencies in work that test reports and inspections indicate non-conformance with the Issued for Construction Documents.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors to requirements in AWS D1.1/D1.1M for stud welding.

PART 3 - EXECUTION

3.01 ERECTION AND INSTALLATION

- A. Protected Zones: Follow the same requirements as in Article 2.02.A of this Specification Section.
- B. Reference Standards: Erect and install structural steel in conformance with the applicable requirements of AISC 360 and AISC 341. Hold a readiness review meeting with the parties involved with the steel erection including the Resident Engineer after shop drawings and erection plans are approved.

- C. Special Care: Avoid marking or distorting the structural steel in unloading, handling, and erecting the structural steel materials. Avoid the damage to any shop paint. If using temporary braces or erection clips, avoid the creation of unsightly surfaces upon removal. Plan and execute all operations in such a manner to insure that the close fit and neat appearance of the structure.
- D. Prior to erection, verify elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements. Proceed with installation only after correcting unsatisfactory conditions.
- E. Lines and Levels: Install structural steel accurately at established lines and levels. Install steel plumb and level before commencing bolting. Install in accordance with accepted shop drawings and actual conditions, true and horizontal or perpendicular, level and square, with angles and edges parallel with related lines of the structure.
- F. Temporary Bracing: Provide temporary bracing as required and keep in position until final completion. Brace and carefully handle shop fabricated items subject to damage to prevent distortions or other damage. Properly brace all items installed before placing concrete to prevent distortion by pressure of concrete. Watch and maintain bracing during concreting operations.
- G. Bases and Bearing Plates to be Grouted:
 - 1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surfaces of base and bearing plates. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain.
 - 2. Set base and bearing plates accurately using a high-strength, non-shrink grouting mortar in accordance with non-shrink grouting, installation, as stated in the Issued for Construction Documents.
 - 3. Support bases and plates that require grouting at the correct level by means of adjustment nuts and washers on anchor bolts or permanent shims that are promptly grouted after the structural steel has been plumbed.
- H. Dissimilar Metals: Do not place dissimilar metals in contact with each other. Add nonmetallic spacers or other approved material between dissimilar metals, even if the metal is coated.
- I. Erection and Assembly: After erection and field assembly, align the various members forming parts of the completed structure and adjust accurately before fastening. Conform to the applicable tolerance requirements of AISC 303.
- J. Erect elevator hoistway structural steel support framing connection to the concrete platform structure with a sufficient time after placing and compacting station fill. Consult the project geotechnical engineer for the required time for consolidation.
- K. Splice members only where indicated. Fasten splices of compression members after bringing abutting surfaces completely into contact.
- L. Do not use thermal cutting during erection unless approved by the Resident Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M. Cutting will be permitted only on secondary members, which are not under stress, as acceptable to the Resident Engineer.
- M. Drift Pins: Drift pins are permitted only to bring together several parts or components. Do not use fit-up bolts and drift pins to bring out-of-tolerance fabricated members and

components into alignment. Do not use drift pins with such force as to distort or damage the material.

N. Erection Connections:

1. Place holes, plates, or other attachments required by the erector so as not to interfere with or cause any other detrimental effect to structural members or connections.
2. Remove erection bolts and attachments not shown on the Issued for Construction Drawings.
3. Fill holes not shown on the Issued for Construction Drawings with plug welds and grind smooth at exposed surfaces.

O. Welded Headed Stud Shear Connectors: Prepare steel surfaces as specified by manufacturer of shear connectors. Use automatic end welding of heads stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.02 WELDING

A. Field Welding and Field Welding Repairs: Refer to Section 05 05 23 - Metal Fastenings for welding requirements and as stated in the Issued for Construction Contract Documents.

3.03 BOLTING

A. Field Bolting: Refer to Section 05 05 23 - Metal Fastenings for bolting requirements and as stated in the Issued for Construction Documents.

B. High-Strength Bolting: Assemble joints in accordance with AISC Specifications for Structural Joints Using ASTM F3125/F3125M Bolts.

3.04 FIELD QUALITY CONTROL

A. Field Welding Procedures and Personnel: Refer to Section 05 05 23 - Metal Fastenings and the requirements as stated in the Issued for Construction Documents.

B. Plumb, level, and align individual pieces in accordance with the requirements of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."

C. Field Survey: Make an accurate survey of alignments and elevations of all steel members as noted on the Issued for Construction drawings.

1. During construction of the steel frame, survey the column locations and splice elevations as each column tier is erected. Submit survey reports indicating this information within 24 hours after the survey for review prior to erecting the subsequent tiers.
2. Establish permanent benchmarks by a registered Professional Surveyor employed by the Contractor in accordance with the requirements of Issued for Construction Documents.
3. Where locations vary beyond the allowable tolerances, notify the Resident Engineer and take necessary corrective measures and modify details and/or procedures as required and approved.

D. Field Bolting Testing and Inspection: Refer to Section 05 05 23 - Metal Fastenings as stated in the Issued for Construction Documents.

- E. Inspect field-assembled and installed high-strength bolting upon direction of the Resident Engineer. The independent laboratory must torque-test bolts in accordance with RCSC Specification for Structural Joints using F3125/F3125M Bolts.
- F. Perform visual inspection and non-destructive testing (NDT) of welds in accordance with WSDOT Standard Specifications Section 6-03.3(25). For occupied structures governed by the International Building Code, inspections must conform to the International Building Code, with the exception that pedestrian structures (bridges or walkways) weld inspection must follow WSDOT Standard Specifications Section 6-03.3(25).
- G. Correct deficiencies in work that test reports and inspections indicate non-conformance with Issued for Construction Documents.

3.05 PROTECTION

- A. Use fire-retardant blankets to completely contain arcs and spatter associated with welding.
- B. Protected Zones:
 - 1. Refer to elsewhere in this Specification Section.

END OF SECTION

SECTION 05 52 30.10

BARRIER CABLE SYSTEMS FOR PEDESTRIAN BARRIER

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes requirements for pedestrian barrier cable systems.

1.02 REFERENCES

- A. Post-Tensioning Institute (PTI):
1. Technical Note 14, Design of Prestressed Barrier Cable Systems.
 2. PTI M10.2 Specification for Unbonded Single Strand Tendons.
- B. PTI M10.4 Specification for Seven Wire Steel Strand Barrier Cable Applications.
- C. American Society for Testing and Materials (ASTM):
1. 1. ASTM A475 Standard Specification for Zinc-Coated Steel Wire Strand.
 2. 2. ASTM A36 Standard Specification for Carbon Structural Steel
- D. International Code Council (ICC).
- E. ICC International Building Code (IBC).
- F. American Society of Civil Engineers (ASCE) / Structural Engineering Institute (SEI):
1. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures.
- G. Definitions:
1. Anchorages: A mechanical device comprising all components required to anchor the prestressing steel and permanently transfer the post-tensioning force from the prestressing steel to the structure.
 2. Barrier strand: Seven-wire prestressing steel strand used in barrier cable systems.
 3. Back-stressing: A stressing procedure that ensures that the wedges are properly seated into the anchor at a given location on the tendon.
 4. Cable: A term used by some to denote a prestressing strand or a single-strand tendon.
 5. Final Effective Force: Force remaining in prestressing steel after all losses have occurred.
 6. Hand Seating Tool – A small handheld device used to properly align (seat) the wedges in the anchor prior to attaching the jack to the strand for stressing.

7. Initial Tensioning Force: The initial force that is applied to a barrier cable that will result in the retention of the minimum final effective force as specified by the Issued for Construction documents.
8. Jack: A mechanical device used for applying stressing force to the barrier cable.
9. Jacking Force: See Initial Tensioning Force.
10. MUTS: Minimum Ultimate Tensile Strength.
11. Seating Loss: The relative movement of the wedges into the anchor cavity during the transfer of the prestressing force to the anchorage, resulting in some loss of prestressing force.
12. Strand: High-strength prestressing steel wires helically placed around a center wire.
13. Wedges: Pieces of tapered metal with serrations, which bite into the prestressing strand during transfer of prestressing force.

1.03 SUBMITTALS

A. Submit:

1. Shop Drawings: Installation drawings including plans, elevation, section, details, and note stating that the shop drawings were prepared by or under the supervision of an installer qualified per Article 1.03.B.4, herein, detailing barrier cable layout and installation procedures including the following:
 - a. Cable run arrangement, length, anchor location, anchor details and designation of barrier cables. Installation and fabrication details of all angles, posts or fabricated steel members needed and their anchoring into the structure.
 - b. Stressing procedures and jacking forces to result in the final effective forces.
2. Calculations stamped by a Professional Civil or Structural Engineer licensed in the state of Washington and produced in accordance with the International Building Code and Post-Tensioning Institute, and provide a minimum of the following:
 - a. Calculation of tendons minimum force for anti-sag criteria.
 - b. Calculation of tendons maximum force under design loads and verification of acceptance criteria for each cable run.
 - c. Verification of the maximum deflection criteria for the barrier under the design load for each significant cable.
 - d. Determination of the pre-tensioning requirements to cover all criteria above including losses unless a specific procedure is in place to compensate for seating losses.
 - e. Load summary of permanent/accidental forces applied by the barrier for verification of their acceptability by the Resident Engineer.

- f. Design calculations for all steel posts, angles or hardware used in the construction of the barrier cable. Perform the design based on design loads including direct force on steel posts used in the barrier construction.
 - 3. Operation and Maintenance Manual: The system installer must submit a system maintenance, and operations guide to Sound Transit providing a minimum of the following data:
 - a. Recommended inspection periodicity and procedures.
 - b. Maintenance and repair procedures for minor damage.
 - c. Maintenance procedure for cable anchors to allow for ease of maintenance and replacement without damaging existing structural elements.
 - d. Action plan in case of major damage impairing the system functionality.
- B. Transmit:
 - 1. Certified Mill Test Reports upon request for each coil, reel, or pack of strand containing as a minimum the following information:
 - a. Type and Grade.
 - b. Coil Number.
 - c. Ultimate Tensile Strength.
 - d. Nominal Diameter and Steel Area of Strand.
 - e. Modulus of Elasticity.
 - 2. Hardware Data Sheets for each hardware component used in the cable anchoring system.
 - 3. Stressing records filled out by testing agency during stressing operations on the cable systems:
 - a. Name of the project.
 - b. Date of approved installation drawings used for installation and stressing.
 - c. Date of stressing operation.
 - d. Weather conditions including temperature and rainfall.
 - e. Name of the individual in charge of stressing operation.
 - f. Serial or identification numbers of jacks and gauge.
 - g. Date of jack and gauge calibration certifications.
 - h. Gauge pressure to achieve required stressing force per supplied calibration chart.
 - i. Tendon identification mark.

- j. Actual gauge pressure.
- k. Representative photographs.
- 4. Qualifications:
 - a. Design and install the barrier cable system in accordance with the following:
 - 1) Design the barrier cable system in its entirety under the responsibility of the specialty barrier cable system company.
 - 2) The professional engineer producing the system design calculations must have a minimum experience of five (5) years and ten (10) barrier cable projects of similar size and scope.
 - 3) Perform the installation by a PTI Certified Level 2 Installer of Unbonded Post-Tensioning with a minimum experience of five (5) years and ten (10) barrier cable projects of similar size and scope.
 - 4) Supply the properly calibrated stressing equipment for the application and/or barrier cable systems that are necessary to perform the work. Follow calibration requirements listed in PTI's Specification for Unbonded Single Strand Tendons.
 - b. Prequalified Vendors:
 - 1) Dywidag-System International, USA Inc.
 - 2) Approved equal satisfying Article 1.03.B.4, herein this specification.
- 5. Warranty: Provide a written warranty letter as specified in Article 1.04.A, herein this specification, at the completion of the project.

1.04 WARRANTY

- A. Minimum period of five (5) years on all materials, components and their installation.

PART 2 — PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. The barrier cable system must be compliant with the International Building Code and meet the following requirements.
- B. Pedestrian:
 - 1. Design barrier cable systems for pedestrian design loads per ASCE 7. Perform strength verification of all the system components (cable, anchoring, hardware, posts, brackets, and structure members they attach to) with a 1.6 load factor.
 - 2. Minimum of 42 inches in height constructed such that a 4 inch diameter sphere must not pass through any opening up to a height of 34 inches. Above 34 inches, an 8 inch diameter sphere not to pass through the openings.

3. Design deflections to insure the top rail minimum elevation of 42 inches and cable spacing (4 inch maximum) is maintained with maximum deflection.
 4. Design must conform to Post-Tensioning Institute Technical Note 14, Design of Prestressed Barrier Cable Systems.
- C. Design, fabricate and install the barrier cable system, including all the system's fabricated steel components and anchoring to the structural members with a single specialty company with qualifications in compliance with paragraph Article 1.03.B.4, herein.
- D. Do not design barrier cables running through an expansion joint.

2.02 MATERIALS

A. Prestressing Steel:

1. Use seven-wire steel strand for prestressing steel barrier cable which consist of one center wire with six wires spirally wrapped around it. Single wires before galvanizing must meet the requirements of ASTM A 416, grade 250.
2. Galvanize all exposed barrier cable elements. Zinc coating must comply with ASTM specification A 475 Class A, table 2 coating weight. Apply galvanized coatings by either hot-dip or electro plating process to ensure complete zinc around each individual wire of the strand.
3. Use of polyethylene (plastic) or epoxy coated strands is not permitted.
4. Identify strand pack reels or coils at the source as to grade, coil number and type.
5. Performance Criteria:
 - a. Strand used for barrier cable must meet the minimum requirement of the appropriate ASTM specification as the project specification. No exception will be permitted.
 - b. The galvanized coating used for the barrier cable must be free of damage so that the uncoated steel is not exposed to the elements. Reject cracked or brittle coating.

B. Anchorage:

1. Design wedge type anchorage systems to develop at least 95 percent of the minimum ultimate breaking strength of the barrier cable strand and to comply with the requirements of PTI's Specification of Single Strand. Unbonded Tendons must be used at the termination of each barrier cable to attach the cable to its support member. The anchor (casting or machined barrel anchor) and the wedge is considered as one unit. Do not mix component parts from different manufacturers.

C. Barrier Cable Hardware and Embeds:

1. Encapsulated Anchors: Castings must be nonporous and free of sand, blow holes, voids, and other defects. Casting shapes are permitted to be rectangular square, or cylindrical with a conical hole designed to receive the matched tapered wedges. Use both the casting machined barrel anchors are in the same way and rate them to meet the load requirement specified. Cast or drill inserts

into the support member. All inserts must meet the ultimate pull out and shear load requirements of the building code.

2. Provide galvanized hitch barriers as specified in Issued for Construction documents, mounted approximately 18 inches above finish floor to the center of the plate and centered on the stall to increase safety and protect the integrity of the barrier system.

D. Wedges:

1. Wedges are made from carbon steel bar and are hardened by heat treatment after the indentations are machined on the inside and is designed to penetrate and hold the barrier cable. The wedges must be under sufficient force to have the teeth engaged into the barrier cable to ensure proper working action of barrier cable systems. The procedures used to accomplish this task must never exceed the maximum lateral force allowed by the column. Zinc plate or galvanize wedges for corrosion resistance.

E. Bearing Plates:

1. Utilize a steel plate when required by design. See Section 05 12 00 - Structural Steel Framing for steel plate requirements. Adjust size and thickness to meet the design requirement.

F. Fabricated Structural Steel Members:

1. Design brackets or steel posts used as attachments to structural members to handle both the applied prestressing force and the forces resulting from design loads. Include the mechanical steel properties, ultimate pull out, and shear load ratings in the ultimate strength of such devices of the hardware and/or welds used in attaching the device to the supporting structural member.
2. Protect and treat the barrier system and all hardware from corrosion and such that their visibility is enhanced to patrons.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Cast-In Barrel Anchors:

1. Stress cast-in and barrel anchors with a hydraulic stressing jack to provide the specified tension in the cable after all seating losses. Backstressing according to Article 3.01.D, herein, to assure proper wedge seating.

B. Installation of Barrier Cable Through Intermediate Structure:

- C. At intermediate structure, provide sleeves ensuring a hole which is a minimum 1/8inch diameter larger than the barrier cable diameter used (including coating material).

Structural Steel Angles & Channels:

1. Where applicable, install structural steel support or anchoring angles or channels, as shown in the Shop Drawings, on the face of the channels or HSS post. Develop the connections to the channels or HSS post to the maximum design load for all the barrier cables at the location.

2. Where applicable, install structural steel support or anchoring channels as shown in the shop drawings. Position these structural members in the proper alignment to avoid kinks in the barrier strands. Anchor steel channels to the structure prior to cable installation.
 3. Stressing Considerations:
 4. The licensed design engineer to specify the minimum final effective force required (after back-stressing).
 5. Stress all barrier cables to the stressing forces defined in the project approved shop drawings.
 6. Back-stress all anchorages. Perform this back-stressing procedure after stressing the cable. Remove the jack after achieving and placing the initial tensioning force so that the jack nose is bearing on the opposite side of the bearing member. Then stress the cable at a force equal to 80 percent of the MUTS of the strand.
- D. Finishing of Anchor Recesses
1. Clamp barrier cable as close as possible to the end seat or barrel housing to prevent strand separation. Remove barrier cable tails within 1 inch from the face of the support structure using either an oxyacetylene torch, a metal cut off saw, a hydraulic shear, or a plasma cutting device. Do not perform this operation in rainy weather.
 2. Cover exposed cable ends with a pressed on cap to conceal exposed cable ends. Fill anchor recessing with non-metallic non-shrink grout as soon as practical, with one continuous application. Do not use the grout containing chlorides or other chemicals known to be deleterious to the steel.

3.02 CABLE TENSIONING

- A. Minimum cable tension shall be 225 lb.
- B. Maximum cable tension shall not exceed 500 lb per cable based on the capacity of the supporting structure, nor shall it exceed the manufacturer's published allowable tension for the specific cable size furnished. The lower value shall govern.
- C. Within these limits, adjust cable tension to suit span length and required deflection performance.
- D. Tension outside of these limits, resulting in inadequate performance, excessive deflection, or damage to cables or supports, will not be permitted.

3.03 ADJUSTING

- A. Seat wedges initially at 80 percent MUTS into the barrel housing to ensure engagement of the wedge teeth into the barrier cable. The final force of the barrier cable is achieved mechanically through the threading adjustment at the stem of the anchoring device into the insert. Backstress the cable installed in these devices in accordance with Article 3.01.D, herein, either before or after the installation of the anchor.

3.04 FINAL INSPECTION & PROTECTION

- A. At anchorage supporting structures, seal the hold at the barrier cable that passes through a hole in the supporting structures to anchorage to prevent water from following a path of barrier cable to the anchorage unless the barrier cable slope prevents that from happening.
- B. When cable tension is in question, perform tension verification by means of an approved cable tension gauge without removing or damaging the cables.
- C. Sound Transit requires independent special inspection to ensure barrier cable system is installed in accordance with the Issued for Construction Documents and installation drawings. Special inspector must verify the conformance to the requirements of Article 2.01.B.2, herein, and Article 2.01.B.3, herein this specification. Special inspector must submit inspection report to Sound Transit.

END OF SECTION

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SECTION 07 16 13

POLYMER MODIFIED CEMENT WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes polymer-modified cement waterproofing.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying polymer-modified cement waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance. Contractor shall maintain qualified personnel who have received product training by manufacturer's representative.

1.05 FIELD CONDITIONS

- A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.
- B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 45 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.01 PREPACKAGED, POLYMER-MODIFIED CEMENT WATERPROOFING

- A. Negative-Side, Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with water or polymer admixture to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade,

is breathable, resists negative-side hydrostatic pressure, and has properties complying with or exceeding the criteria specified below.

1. Watertight under hydrostatic pressure. (Rendering mortars absorbing less than 64 grams/m² • h (91 grains/ft² • h) are considered watertight.)
2. Compressive Strength: Minimum 3000 psi (20.7 MPa) at 28 days when tested in accordance with ASTM D-695.
3. Flexural Strength: 10-12 N/mm² at 20°C after 28 days when tested according to ASTM C348.4)
4. Bond Strength: Minimum 220 psi (1.5 MPa) at 14 days when tested in accordance with ASTM C321 or 180 psi at 28 days when tested in accordance with ACI 503R-30, Modified.
5. Vapor Permeability ASTM E96: 28 days greater than 10 perms (Vapor Permeable).
6. Color: Gray.

2.02 ACCESSORY MATERIALS

- A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections and compatible with substrate and other materials indicated.
- B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.
- C. Portland Cement: ASTM C150/C150M, Type I.
- D. Slurry-Coat Sand: ASTM C144.
- E. Trowel-Coat Sand: ASTM C33/C33M, fine aggregate.
- F. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and to not create a vapor barrier.
- G. Water: Potable.

2.03 MIXES

- A. Prepackaged Polymer-Modified Cement Waterproofing: Add prepackaged dry ingredients to mixing liquid according to manufacturer's written instructions. Mix with mechanical mixer or by hand to required consistency.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Comply with manufacturer's written instructions.
- B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.
- C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- D. Stop active water leaks with plugging compound.
- E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch (1.6 mm) wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch (25 mm) deep. Fill reveal with patching compound flush with surface.
- F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

3.02 APPLICATION

- A. General: Comply with waterproofing manufacturer's written instructions for application and curing.
1. Surfaces must be Saturated Surface Dry (SSD), with no standing water at time of application.
 2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:
 - a. Onto every substrate in areas indicated for treatment, including pits, sumps and similar offsets and features.
 3. Number of Coats: Number required for specified water permeability, but no fewer than two.
 - a. Vigorously work first coat onto the substrate, forcing the material into surface voids. Apply each subsequent coat into full contact with previous coat.
 - b. Allow manufacturer's recommended time between coats. Dampen surface between coats.
- B. Final Coat Finish: Smooth troweled.
- C. Curing:
1. Moist-cure waterproofing for not less than three days immediately after application has set, followed by air drying prior to being placed in service unless otherwise recommended in writing by manufacturer.

END OF SECTION

SECTION 07 42 13.13
FORMED METAL WALL PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

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

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal 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 panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

- 1. Wind Loads: As indicated on Drawings.
- 2. Other Design Loads: As indicated on Drawings.
- 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at the following test-pressure difference:

- 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

- 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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

2.02 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Reveal-Joint, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with narrow reveal joint between panels.

- 1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating

designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

- a. Nominal Thickness: Match existing, adjacent panels.
- b. Exterior Finish: Two-coat fluoropolymer.
- c. Color: Match existing, adjacent panels.

2. Panel Coverage: Match existing, adjacent panels.

2.03 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide EPDM or PVC sealing washers for exposed fasteners.
- D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer in color matching that of the adjacent existing sealant.
 2. Provide sealant color matching color of adjacent panel sealant.
- E. Provide rigid insulation backing to match type and thickness of used in conjunction with the existing metal panels system.

2.04 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.05 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant to seal lapped joints of metal panels, using sealant as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

- 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.

3.03 CLEANING

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

END OF SECTION

SECTION 07 54 19

POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Adhered polyvinyl chloride (PVC) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Roof insulation.
5. Insulation accessories and cover board.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation thickness and slopes.
5. Roof plan showing orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.

C. Samples: For the following products:

1. Roof membrane and flashing, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.03 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

- a. Submit evidence of compliance with performance requirements.
- 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- B. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.
- C. Field Test Reports:
 - 1. Concrete internal relative humidity test reports.
 - 2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- D. Field quality-control reports.
- E. Sample warranties.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturers: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.
 - 2. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.06 WARRANTY

- A. Provide a manufacturer's warranty that has no dollar limit, cover full system water-tightness, and has a minimum duration of ~~23~~0 years from date of Substantial Completion. Submit Sample certificate.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

- D. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897: as indicated on the drawings.
- E. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 - 1. Fire/Windstorm Classification: Class 1C-210.
 - 2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.
 - 3. Provide a complete roof system assembly that is rated and installed to resist window loads calculated in accordance with ASCE 7-22 and validated by uplift resistance testing in accordance with FM test procedure. Base wind uplift measurements on a design wind speed of 98 mph in accordance with ASCE 7-22 and other applicable building code requirements.
- F. Energy Star Listing: Roofing system to be listed on the DOE's Energy Star "Roof Products Qualified Product List" for low steep-slope roof products.
- G. Energy Performance: Roofing system to have an initial solar reflectance of not less than 0.74 and an emissivity of not less than 0.85 when tested in accordance with ANSI/CRRC S100.

2.02 POLYVINYL CHLORIDE (PVC) ROOFING

- A. PVC Sheet Type IV: ASTM D4434/D4434M, fabric reinforced.
 - 1. Subject to compliance with the requirements identified herein, provide Sure-Flex PVC Membrane as manufactured by Carlisle Syntec Systems or approved equivalent.
 - a. Thickness: 60 mils (1.524 mm).
 - b. Exposed Face Color: White or Light Gray.

2.03 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- E. Slip Sheet: Manufacturer's standard, of thickness required for application.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.04 UNDERLAYMENT BOARD

- A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Surface Finish: Factory primed.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.05 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Thickness:
 - a. Base Layer: 1-1/2 inches (38 mm).
 - b. Upper Layer: 2 inches (50 mm).
- B. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation.
 - 2. Minimum Thickness: 1/4 inch (6.35 mm).
 - 3. Slope:
 - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.

2.06 INSULATION ACCESSORIES AND COVER BOARD

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
- C. Fiber-Reinforced Cementitious Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board.
 - 1. Thickness: 1/2 inch (13 mm).

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

3.02 PREPARATION

- A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 - 1. Submit test result within 24 hours of performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.03 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie into existing roofing to maintain weathertightness of transition.

3.04 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 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.
 - 4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.
 - 5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
 - 6. Loosely lay substrate board over roof deck.

3.05 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 - 1. Install base layer of insulation with end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.
 - a. Locate end joints over crests of decking.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
 - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
 - a. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - e. Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

- 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.06 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.07 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.08 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
 - 1. Infrared Thermography: Testing agency surveys entire roof area using infrared color thermography according to ASTM C1153.
 - a. Perform tests after 24 hours flooding of the roof.
 - b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing.
 - c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - d. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture, if any.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

3.010 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system 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.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Formed low-slope roof sheet metal fabrications.
2. Formed wall sheet metal fabrications.

1.02 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Butyl sealant.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Include details of termination points and assemblies.
3. Include details of special conditions.
4. Include details of connections to adjoining work.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.
- B. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.
- C. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Special warranty.

1.05 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 ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.06 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking more than a No. 8 rating when tested in accordance with ASTM D4214.
 - 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

2.01 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- D. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-210. Identify materials with name of fabricator and design approved by FM Approvals.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless Steel Sheet: ASTM A240/A240M, Type 316, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: ASTM A480/A480M, No. 3 (coarse, polished directional satin).

C. For size, profile, and shape refer to drawings.

2.03 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.04 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: 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. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength stainless steel rivets suitable for metal being fastened.
 - 2. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- C. 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.
- D. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- E. Bituminous Coating: Cold-applied asphalt emulsion in accordance with STM D1187/D1187M.
- F. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.05 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.

4. 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.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. 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.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate concealed cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

2.06 DRAINAGE SHEET METAL FABRICATIONS

A. Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch- (2400-mm-) long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.
5. Accessories: Wire-ball downspout strainer.

B. Downspouts: Fabricate circular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.

1. Fabricate from the following materials:
 - a. Stainless Steel: 0.0156 inch (0.396 mm) thick.

2.07 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners. Fabricate from stainless steel, 0.0250 inch (0.635 mm) thick, minimum.
- B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from stainless steel, 0.0188 inch (0.477 mm) thick.

PART 3 - EXECUTION

3.01 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lap joints not less than 2 inches (50 mm).
- B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lapp joints not less than 4 inches (100 mm).

3.02 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
 - 6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 - 7. Do not field cut sheet metal flashing and trim by torch.
- 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 stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact, ferrous metal.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.
 - a. Form joints to completely conceal sealant.
 - b. 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.
 - c. Adjust setting proportionately for installation at higher ambient temperatures.
 - d. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Section "Joint Sealants".

3.03 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches (100 mm) over base flashing.
3. Lap counterflashing joints minimum of 4 inches (100 mm).

3.04 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.05 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

3.06 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for sealant and backing materials for sealing of joints in construction. In general this includes, but is not limited to, the following:
 - a. All locations noted on Issued for Construction Drawings as sealant or caulking, excluding joint fillers indicated by 03 15 00 – Concrete Accessories.
 - b. Penetrations in exterior metal wall panel systems.
 - c. Perimeter joints between exterior metal wall panel systems and door frames, aluminum windows, or louvers.
 - d. Horizontal/ Vertical architectural control, construction, isolation, and expansion and contraction joints.
 - e. Perimeter joints between interior wall surfaces and frames of doors or windows.
 - f. Tape for isolation and gasketing as indicated.
 - g. As required for continuous Weather Air Barrier at penetrations of exterior walls.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. Fenestration and Glazing Industry Alliance (FGIA/AAMA) AAMA 800 - Voluntary Specifications and Test Methods for Sealants.
2. American Society for Testing and Materials International (ASTM):
 - a. ASTM C834 - Standard Specification for Latex Sealants
 - b. ASTM C920 - Specification for Elastomeric Joint Sealants.
 - c. ASTM C1193 - Standard Guide for use of Joint Sealants.
 - d. ASTM C1311 - Standard Specification for Solvent Release Sealants.
 - e. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
 - f. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.

- g. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- 3. South Coast Air Quality Management District (SCAQMD):
 - a. SCAQMD Rule 1168 - Adhesive and Sealant Applications, with Amendments.
- 4. Underwriters Laboratories Inc. (UL):
 - a. UL 94 HF-1 - Measure of a material's flammability or burning time before self-extinguishment (burning stops within 2 seconds; afterglow less than 30s; no burning drips allowed).

1.03 SUBMITTALS

A. Submit:

- 1. Sealant Schedule: Identify areas of use by each product submitted according with Sealant Schedule in this Section:
 - a. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following: Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 1) List of backing materials approved for use with the specific product.
 - 2) Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 3) Substrates the product should not be used on.
 - 4) Substrates for which use of primer is required.
 - 5) Substrates for which laboratory adhesion and/or compatibility testing is required.
 - 6) Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 7) Sample product warranty.
 - 8) Certification by manufacturer indicating that product complies with specification requirements.
- 2. Samples for Initial Selection: Submit initial color samples in the form of manufacturer's bead samples consisting of strips of actual products showing full range of colors available for each product.
- 3. Material Certification: Submit written certification from sealant manufacturer stating that materials forming joint substrates and joint backings (e.g., concrete, fluoropolymer coatings) have been tested for compatibility and adhesion with proposed joint sealants and are suitable for the use intended as specified; certification shall state that proposed sealant has been tested for non-staining characteristics when applied to precast concrete. Include recommendations for primers and substrate preparation needed to obtain adhesion.

4. Adhesion Test Log: Submit sample of test log containing requirements listed in Article 3.04, herein.

B. LEED Submittals:

1. Where LEED certification is required by the project, submit the same documentation for approval as required by GBCI as a project submittal. Highlight the relevant LEED information.
2. LEED documentation is to be submitted separately and titled LEED SUBMITTAL.
3. Building Product Disclosure and Optimization credit data: Submit data to support the LEED SUBMITTAL.

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain joint sealant materials for each application from a single manufacturer.
- B. Sealant Certification: Submit written certification from sealant manufacturer stating that materials forming joint substrates and joint backings (e.g., concrete, fluoropolymer coatings) have been tested for compatibility and adhesion with proposed joint sealants and are suitable for the use intended as specified; certification shall state that proposed sealant has been tested for non-staining characteristics when applied to precast concrete. Include recommendations for primers and substrate preparation needed to obtain adhesion.
- C. Preconstruction Compatibility and Adhesion Testing: Prior to installation of joint sealants, field test their adhesion to joint substrates of each type encountered and determine if priming and other specific joint preparation techniques are required. Perform tests under normal environmental conditions that will exist during actual installation in accordance with Field Quality Control requirements in this section. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the Work.

1.05 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
 1. Ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
 2. Joint substrates are wet due to rain, condensation, or other causes.
 3. Joint Width Conditions: Do not proceed with installation of joint sealant when joint widths are less than or larger than allowed by joint sealant manufacturer for application indicated.
 4. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.06 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.
- B. Verify available warranties and warranty periods for joint-sealant installation.
 1. Warranty Period: Two (2) years from date of Acceptance.

- C. 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.
- D. Verify available warranties and warranty periods for joint sealants:
 - 1. Warranty Period: Five (5) years from date of Acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Color And Texture Criteria (Exterior Exposed to View Locations): Unless noted otherwise provide color of joint sealant selected from manufacturer's standard colors to match adjacent colors, as selected by Architect.
 - 1. At Color Coated (PVDF) Aluminum Framing: Provide custom color to match the Resident Engineer's approved (PVDF) color sample.
 - 2. Sealants (Type B) used in horizontal applications shall match adjacent material color.
- C. Surface Burning Characteristics: All materials used within the building envelope must meet Smoke developed index of 450 or less, and flame spread index of 25 or less, Class A, when tested in accordance with ASTM E84.
- D. Sealants used within the building envelope shall comply with low VOC limits found in SCAQMD Rule 1168.

2.02 PRODUCTS

- A. Sealants:
 - 1. Type "A" Sealant: One-part, neutral-cure silicone elastomeric sealant meeting requirements of ASTM C920, Type S, Grade NS, Class 25 minimum. Include primer required for porous substrates as required by manufacturer:
 - a. Application: Exposed vertical and horizontal joints not subject to foot or vehicle traffic.
 - b. Acceptable products include:
 - 1) Dow Corning "DOWSIL 795/790 Building Sealant".
 - 2) General Electric "Silglaze SSG4000".
 - 3) Tremco "Spectrem 2".
 - 4) or approved equal.
 - 2. Type "B" Sealant: Self-leveling 2-part elastomeric urethane meeting requirements of ASTM C920, Type M, Grade P, Class 25 minimum, Use T. Include primer required for porous substrates as required by manufacturer:

- a. Application: Interior and exterior horizontal joints subject to foot or vehicle traffic.
 - b. Acceptable products include:
 - 1) SIKA USA, Sikaflex-2c SL.
 - 2) BASF "MasterSeal SL 2".
 - 3) BASF "MasterSeal NP2".
 - 4) Tremco "Vulkem 445SSL".
 - 5) Or approved equal.
3. Type "C" Sealant: Silyl-terminated polyether (STPe) or polyurethane (STPu) elastomeric sealant conforming to requirements of ASTM C920, Type S, Grade NS, Class 50 minimum. Include primer required for porous substrates as required by manufacturer:
- a. Applications: Metal to metal open joints, either back groove or top of surface mounted flashing, exposed to weather, and for bedding thresholds and brake formed flashings.
 - b. Acceptable products include:
 - 1) BASF "Sonolastic 150 VLM"
 - 2) Henry Company "HE925 - BES Sealant"
 - 3) Pecora Corporation, "DynaTrol I-XL Hybrid"
 - 4) Or Accepted Equal
4. Type "D" Sealant: One part paintable acrylic latex sealant complying with requirements of ASTM C834, type OP:
- a. Applications: Low-movement, interior joints not subject to traffic, and not in wet areas:
 - 1) Joints in gypsum drywall, concrete, and masonry.
 - 2) Wall and ceiling control joints at non-fire rated non-acoustic conditions.
 - 3) Other interior joints for which no other type of sealant is indicated.
 - b. Acceptable products include:
 - 1) Pecora Chemical Corporation "AC-20 + Silicone".
 - 2) Tremco "Tremflex 834".
 - 3) Sherwin-Williams "850A".
 - 4) or approved equal.
5. Type "E" Sealant: One part mildew resistant silicone sealant complying with requirements of ASTM C920, Type S, Grade NS, Class 25 minimum:

- a. Applications: Interior joints in wet areas (perimeter of countertops with sinks, restrooms, and shower areas).
 - b. Acceptable products include:
 - 1) Dow Corning "Dowsil 786 Silicone Sealant".
 - 2) General Electric "SCS1702".
 - 3) Pecora Corporation "898 Sanitary Mildew Resistant Silicone Sealant".
 - 4) or approved equal.
6. Type "F Series" Sealants: Non-curing, non-hardening, synthetic rubber sealer, recommended for use by manufacturer where concealed joints are subject to changes in temperature, water and vibration.
- a. Type "F-1": Tape consistency, solvent-free, butyl-based sealant with a solids content of 100 percent; meeting the requirements of AAMA 804.1-85 (as described in AAMA 800). Packaged in rolls with release paper backing:
 - 1) Acceptable products include:
 - a) Tremco "440 Tape".
 - b) Pecora, "Extru-Seal".
 - c) C.R. Laurence Butyl Architectural Glazing Tape.
 - d) Or approved equal.
 - 2) Applications: Exterior metal to metal, and dissimilar materials, compression joints subject to shear.
 - b. Type "F-2": Mastic consistency, one-part non-drying, non-hardening, non-bleeding and permanently resilient butyl sealant, meeting or exceeding ASTM C1311, AAMA 809.2 (as described in AAMA 800):
 - 1) Acceptable products include:
 - a) SIKA 'SikaLastomer 511".
 - b) Pecora, "BA-98".
 - c) Tremco "TremPro JS-773+t".
 - d) Or approved equal.
 - 2) Applications: Exterior metal to metal laps, concealed compression joints, door thresholds, bottom of steel stud tracks.
 - a) For sealing of steel stud tracks in acoustical and fire-rated applications, refer to Section 09 21 16 - Gypsum Board Assemblies.

7. Structural glazing sealant that meets ASTM C1184 standard for structural

- a. Compatibility: Provide joint sealants and accessory materials that are compatible with one another, and with adjacent materials, as demonstrated by sealant manufacturer using ASTM C 1087 testing and related experience.
- b. Color: Match existing.
- c. Type: One-component, neutral-curing silicone sealant.
- d. Modulus: Medium-modulus.
- e. Movement Capability: $\pm 50\%$ (ASTM C719).
- f. Temperature Resistance: -40°F (-40°C) to 300°F (149°C).
- g. Adhesion: Excellent adhesion to glass, metal, and other construction materials.
- h. Weatherability: unaffected by sunlight, rain, snow, ozone, and temperature extremes.
- i. MANUFACTURER: Dow Inc. or approved equal products.
- j. Basis of design: DOWSIL™ 795 Structural Glazing Sealant.

B. Secondary Seal:

- 1. Application: Compression seal to provide watertight secondary seal and resist air pressure differential behind primary sealant and backer-rod at elevator hoistway joints.
- 2. Refer to Drawings for size of joint.
- 3. Acceptable Products include:
 - a. Emseal, Backerseal or accepted equal.

C. Tapes:

- 1. PVC Tape (Type "H"): closed cell PVC foam tape with self-adhesive backing.
 - a. Typical application: Gasket/sealant to reduce air movement, acoustical and vibration isolation and between dissimilar materials and elsewhere indicated.
 - b. Basis of design: Saint Gobain "Norseal V740", or approved equal.

D. Compression Seal:

- 1. Expanding Foam Tape (Type "J"): self-expanding polyurethane foam impregnated with modified acrylic flame retarding polymer meeting UL 94 HF-1 (Self-Extinguishing).
- 2. Typical application: For joints on exterior concrete and masonry envelope and secondary seal for interior side of window to WAB.
- 3. Acceptable Products Include:
 - a. Tremco Willseal 600/600S.
 - b. Bosig "Combband 600".

c. Approved Equal.

E. Acoustic and Fire-Rated Sealant: Refer to Section 09 21 16 - Gypsum Board Assemblies.

2.03 ACCESSORIES

- A. Plastic Foam Backer Rod: ASTM C1330. Preformed compressible, resilient, non-waxing, non-extruding foam, of size, shape and density to suit various conditions and control sealant depth and width. Provide open or closed cell as recommended by sealant manufacturer.
- B. Backer rod type recommended for compatible with sealant by sealant manufacturer, and of type which does not cause staining or discoloration of joint based on field experience and laboratory testing.
- C. Sizes as recommended by sealant manufacturer, with diameter never less than 30 percent greater than width of joint.
- D. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and back surface of joint. Provide self-adhesive tape wherever applicable.
- E. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated.
- F. Cleaners for Nonporous Surfaces: Provide non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Do not proceed with joint sealer work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Cleaning of Joints: Clean joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:
- B. Remove protective films from metal surfaces. Clean metal, glass, and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealants.
- C. Jointing Priming: Prime joint substrates where recommended by joint sealer manufacturer based on preconstruction compatibility and adhesion testing or prior experience. Apply primer undiluted in uniform coating over surface. Confine primers to areas of joint sealer bond; do not allow spillage or migration onto adjoining surfaces.
- D. Masking Tape: Apply masking tape around joints where required to prevent contact of sealant with adjoining surfaces which otherwise would be stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 SEALANT APPLICATION

- A. General: Comply with joint sealer manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Installation Standards: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Installation of Sealant Backings:
 - 1. Install backer rods in all butt type joints receiving sealant where depth of joint exceeds manufacturer's recommendations. Install joint filler using a blunt tool or plain faced roller. Do not puncture, stretch, or twist joint fillers.
 - 2. Do not leave gaps between ends of joint fillers. Remove joint fillers that become wet prior to sealant application and replace with dry material.
 - 3. Generally, install joint fillers to achieve width-to-depth ratio as recommended by sealant manufacturer. Where depth of joint is not sufficient to require joint filler, install bond breaker tape to cover full width and length of joint cavity to prevent three sided adhesion.
- D. Joint Width: Width-to-depth ratio of sealant as recommended by sealant manufacturer. Do not exceed a depth of 1/2 inch when joint is 1/2 inch wide; joints exceeding 1/2 inch in width shall not exceed 1/4 inch in depth.
- E. Mixing: Mix two component sealant in accordance with manufacturer's directions using premeasured units. Do not thin or adulterate sealant in any way.
- F. Installation of Sealants: Apply sealant over backing to uniform thickness in continuous beads, filling all joints and voids solid; superficial pointing with skim bead will not be accepted. Use nozzle of proper size to completely fill the joints.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads, free of air pockets; ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint:
 - 1. Provide concave joint configuration, unless noted otherwise.
 - 2. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- H. Pourable sealants shall be applied by gun or by pouring, filling the joint completely with a slight recessed finish. Additional material shall be added if low spots develop. Seal along outside slab edges of joints to prevent water from entering cavity formed by backer rod.

3.04 FIELD QUALITY CONTROL

- A. Field Testing and Inspection: Perform field test of joint sealant in accordance with test recommended in ASTM C1521: Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints, except as modified below:
 - 1. All testing to be witnessed by Resident Engineer or designated representative.
 - 2. Extent of Testing: Test sealant joints as follows:
 - a. Perform single test for each type of sealant and joint substrate for each responsible contractor.

- b. Test joints to be 5 feet long.
 - c. Allow sealants to cure fully before testing.
- 3. Test Method: Test joint sealants by hand-pull method described below:
 - a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
 - b. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler alongside of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
 - c. For joints with dissimilar substrates, check adhesion to each substrate separately by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
- B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
 - 1. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free from voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
- C. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- D. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- E. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

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SECTION 08 44 13
GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain wall systems.

1.02 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.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer.
- B. Product test reports.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample warranties.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.
- 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.

1.06 WARRANTY

- A. Special Assembly Warranty: Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section "Quality Requirements," to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Glazed aluminum curtain walls 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. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m).

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
3. Cantilever Deflection: Limited to $2l/175$ at unsupported cantilevers.

E. Structural: Test in accordance with ASTM E330/E330M 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.

F. 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.

2.02 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Basis of Design: Kanweer 1600 Series

Other acceptable products:

1. EFCO 5600 Series
2. Arcadia T500 Series
3. Or Equal: Products of equal size, quality, and performance may be considered. To be accepted as equal, the product must meet or exceed the following criteria:
 - Performance: Must match or exceed the performance specifications of the basis of design products.
 - Quality: Must be of equal or higher quality in terms of material and workmanship.
 - Compatibility: Must be fully compatible with existing systems and components.

B. 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.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Exterior side of the garage.
4. Finish: Clear anodic finish.
5. System: stick or built system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.03 GLAZING

- A. Glazing: Comply with Section "ST-08 80 00 Glazing."
B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.

1. Color: Black.

- C. Glazing Sealants: As recommended by manufacturer.

2.04 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
C. Structural Profiles: ASTM B308/B308M.
D. Steel Reinforcement:
 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: 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 in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.05 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 exterior.
 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.
- F. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.06 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- G. Seal joints watertight unless otherwise indicated.
- H. Metal Protection:
 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- J. Install components plumb and true in alignment with established lines and grades.

3.02 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section "ST 08 80 00 Glazing."

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story.

- C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for glazing for the following:
 - a. Curtain wall and storefronts with sealed insulated units.
 - b. Curtain wall ~~and storefront~~ with single pane ~~windows~~glass units.
 - c. Elevator hoist way glazing.
 - d. Canopy and sloped glazing assemblies.
 - e. Doors with Vision Glass Inserts.
 - f. Smoke baffle assemblies.
 - g. Bird collision deterrent glazing.
 - h. Bullet-resistant glazing.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. American Society for Testing and Materials International (ASTM):
 - a. ASTM C1021 – Standard Practice for Laboratories Engaged in Testing of Building Sealants.
 - b. ASTM C1036 – Standard Specification for Flat Glass.
 - c. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
 - d. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
 - e. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
2. American Architectural Manufacturers Association (AAMA):
 - a. AAMA 800 Voluntary Specifications and Test Methods for Sealants.
3. Code of Federal Regulations (CFR):
 - a. 16 CFR 21 Part 1201 - Safety Standard for Architectural Glazing Materials.
 - b. 40 CFR 59 Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings.

4. Glass Association of North America (GANA):
 - a. GANA (GM) Glazing Manual - Glass Association of North America.
5. American Bird Conservancy (ABC):
 - a. Bird Collision Deterrence Material Threat Factor Reference Standard.
 - b. Prescriptive Rating Guidelines for Bird-friendly Materials.
6. Underwriters Laboratories (UL):
 - a. UL 752 - Protection Standards for Bullet Resistant Glass.

B. Definitions

1. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
2. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.
3. IBC: International Building Code.
4. Laminated glazing: single lite consisting of two or more layers of glass with one or more interlayers as specified herein.
5. Single Pane: Lite consisting of single piece of glass or laminated glass with thickness specified.
6. Interspace: Space between lites of an insulating glass unit.
7. Insulating glass unit is abbreviated "IGU" on the Drawings.
8. Insulated Glass Unit & coating orientation:
 - a. Surface 1: Exterior surface of outer lite (surface facing outdoors of outboard lite).
 - b. Surface 2: Interior surface of outer lite (surface facing indoors of outboard lite).
 - c. Surface 3: Exterior surface of inner lite (surface facing outboard lite).
 - d. Surface 4: Interior surface of inner lite (surface facing indoors of inboard lite).

1.03 COORDINATION

- A. Preinstallation Conference: Conduct conference at Project site:
 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review temporary protection requirements for glazing during and after installation.

1.04 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. LEED Submittals:

1. Where LEED certification is required by the project, submit the same documentation for approval as required by GBCI as a project submittal. Highlight the relevant LEED information.
 2. LEED documentation is to be submitted separately and titled LEED SUBMITTAL.
 3. Building Product Disclosure and Optimization credit data: Submit data to support the LEED SUBMITTAL.
- C. Samples: Minimum 12 inches square:
1. Two (2) samples of each type of glass indicated.
 2. Graffiti-resistant plastic film applied to ~~1/4~~5/8-inch clear laminated glass. Leave 3-inch-wide section untreated. Comply with requirements for water and graffiti repellents, as stated elsewhere in the Contract Documents, for graffiti-resistant plastic film material requirements.
 3. Smoke baffle components including 12-inch lengths of finished shoe, glazing gasket and cap.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, registered in the State of Washington, responsible for their preparation.
- F. Mock-up: As specified in "Quality Assurance" Article herein.
- G. Statement of Qualifications: For Installer.

1.05 QUALITY ASSURANCE

- A. Glass:
1. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated glass manufacturer.
 2. Installer Qualifications: A qualified Installer who employs glass Installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
 3. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
 4. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 5. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC, another certification agency acceptable to the Building Code Official, or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 6. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship:
 - a. Finish areas designated by Resident Engineer.

- b. Do not proceed with remaining work until workmanship, color, and sheen are approved.
- c. Refinish mock-up area as required to produce acceptable work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes:
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.08 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants:
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.09 WARRANTY

- A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, peeling and cracking, and blemishes exceeding those allowed by referenced laminated-glass standard:
 - 1. Warranty Period: Ten years.
- B. Special Warranty, Glass Seals: Provide a written warranty signed by the Manufacturer, the installer and the Contractor, agreeing to repair or replace glass sealing materials which have failed to provide airtight and watertight joints for any reason, or which appear to have failed in adhesion, cohesion, abrasion-resistance, migration-resistance, stain- resistance, general durability or other form of apparent deterioration (excluding inherent qualities and limitations clearly specified in the manufacturer's data which was submitted):
 - 1. Warranty Period: Ten years.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, experienced in design of this Work and licensed in the State of Washington, to design glazing and seal drawings.
- C. Structural Performance: Glazing shall withstand the design loads within limits and under conditions indicated determined according to the applicable code and ASTM E1300, unless otherwise indicated on the Issued for Construction Drawings:
 - 1. Wind load: positive and negative (inward and outward) wind pressures shall be determined by basic wind speed criteria by code. Minimum pressures, except where code allows for less, shall not be less than 20 psf positive and negative.
 - 2. Temperature change (range): 120 degrees f ambient; 180 degrees f material surfaces. Base calculations on materials actual surface temperature due to both solar heat gain and nighttime sky heat loss.
 - 3. Center deflection: for the following types of glass supported on all four edges, provide thickness required that limits center deflection at of the edge of the glass perpendicular to the glass pane, based on design wind pressure, not to exceed 1/175 of the glass edge length or 3/4 inch, whichever is less per Building Code.
- D. Glass Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Safety Glazing: ~~Where safety glazing is indicated, p~~Provide glazing that complies with 16 CFR 1201, Category II.
- F. 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 (SHGC) and Visible Transmittance (VT): 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.
- G. Values for thermal and optical performance properties are as specified in "INSULATING GLASS PRODUCTS SCHEDULE" article herein. Where local code requirements conflict, the most stringent requirements apply.

2.02 GLASS TYPES SUMMARY

- A. GL-1: 1/4-inch-thick clear tempered safety glass.
- B. GL-2: GL-1 5/8 inch laminated glass with graffiti-resistant film applied to ~~one of~~ two sides ~~as indicated~~. Other safety glass may be acceptable pending compliance with performance requirements above.

- C. GL-2A: GL-1 with graffiti-resistant film applied to exposed side and Specular polyester security film applied to interior side at platform signage panel locations.
- D. GL-3: 1/2-inch-thick translucent laminated glass:
 - 1. Sloped Glazing and Overhead Canopy Assemblies: White, 65 percent light transmittance.
- E. GL-4: 1/2-inch-thick clear laminated glass.
- F. GL-5: 1/4-inch-thick clear laminated glass:
 - 1. Vertical Clerestory glazing 12 feet or greater above finished floor.
- G. GL-6: Insulated glazing units 1-inch overall thickness.
- H. GL-6A: Insulated glazing unit with UV bird-collision deterrent pattern on surface 1.
- I. GL-7: GL-6 with graffiti-resistant film applied to one or two sides as indicated.
- J. GL-8: Insulated Glazing Unit with bird-collision deterrent, ceramic frit, and anti-graffiti film applied where indicated.

2.03 MATERIALS

- A. Thickness: ~~4~~5/8 inch unless indicated otherwise.
- B. Glass Color: Clear, unless otherwise indicated.
- C. Strength:
 - 1. Where fully tempered glass is ~~indicated~~used, provide Kind FT heat-treated float glass unless specified otherwise.
- D. Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards:
 - 1. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 2. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

2.04 GLASS PRODUCTS SCHEDULE

- A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Tempered Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated:
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - 2. For uncoated glass, comply with requirements for Condition A.
 - 3. All tempered glass is to be heat soaked. Provide documentation that all tempered glass has been treated.

C. Laminated Glass:

1. ASTM C1172, kind and thickness as scheduled, Class 1 (clear):
 - a. Fully tempered: Kind LFT.
2. Interlayer Material: 0.06-inch polyvinyl butyryl:
 - a. Provide thickness not less than 0.06 for sloped glazing canopy assemblies:
 - 1) Product: Ionoplast by DuPont Glass Laminating Solutions
 - b. Color: ~~As indicated:~~Clear
 - 1) GL-3: Viracon "Arctic Snow" or approved equal.
 - 2) GL-4, GL-5: Clear.
3. Laminating Process: Fabricate laminate glass using laminator's standard heat- plus pressure process to produce glass free from foreign substances and air/glass pockets.
4. Construction: As determined by the delegated design stated in article 1.04.E above.
 - a. GL-3, GL-4: 1/4-inch clear glass, interlayer, 1/4-inch clear glass.
 - b. GL-5: 1/8-inch clear glass, interlayer, 1/8-inch clear glass.

D. Insulating Glazing Units:

1. GL-6, GL-6A, GL-7: 2 layers clear 1/4-inch tempered glass surrounding air space. Total thickness 1 inch. Low-E coating as required to meet performance requirements:
 - a. GL-6A: Where bird deterrence is indicated and surface 1 (exterior face) is outside of the touch zone: Provide UV bird-visible pattern complying with ABC, Prescriptive Rating Guidelines for Bird Friendly Materials on surface 1, Low-E coating on surface 2:
 - 1) Basis of design: Pilkington AviSafe Suncool 70/35.
 - 2) Pattern Complying with ABC Threat Factor $\leq$ 12.
 - 3) Overall reflectance of system including anti-graffiti film $\leq$ 15 percent.
 - b. Where both bird deterrence and anti-graffiti film are required by the Contract Documents refer to GL-8.
2. GL-8: 2 layers 1/4-inch clear tempered glass surrounding air space with ceramic frit pattern on surface 2 complying with ABC, Prescriptive Rating Guidelines for Bird Friendly Materials; Low-E coating as required to meet performance requirements on surface 3 Total thickness 1 inch. Anti-graffiti film applied where indicated:
 - a. Pattern Complying with ABC Threat Factor $\leq$ 30.
 - b. Overall reflectance of system including anti-graffiti film $\leq$ 15 percent.
 - c. Assembly Maximum U factor:
 - 1) Fixed units: 0.38
 - 2) Operable units: 0.40

- 3) Comply with locally adopted building codes where more stringent requirements apply.
 - d. Assembly Maximum Solar Heat Gain Coefficient (SHGC):
 - 1) 0.40 at units.
 - 2) Comply with locally adopted building codes where more stringent requirements apply.
 - e. Visual Light Transmittance: 1.1 times SHGC.
- 3. Bullet- Resistant Glazing:
 - a. Where indicated on the contract documents, provide bullet-resistant glazing tested and certified per UL 752 - Level 3.
 - b. Laminated non-splinter glass-clad polycarbonate.
 - c. Where the thickness of bullet-resistant glazing conflicts with the specified glazing construction, the thickness of the bullet-resistant construction shall govern.
 - d. Where used as part of an IGU and in aluminum-glazed curtain wall, or storefront systems. the entire system shall be rated per UL 752.
- E. Standard Glazing Unit Dimensions: Provide glass units in the following sizes, applicable to the applications indicated:
 - 1. Standard Glazing Unit Sizes for Canopy / Elevator shaft:
 - a. 23-1/2 by 47-1/2 inches.
 - b. 29-1/2 by 47-1/2 inches.
 - c. 47-1/2 by 47-1/2 inches.
 - d. 33-1/2 by 71-1/2 inches.
 - 2. Standard Glazing Unit Sizes for Windscreen / Elevator Shaft Glazed Assemblies:
 - a. 33 by 47 inches.
 - b. 33 by 33 inches.
 - c. 47 by 47 inches.

2.05 GLAZING ACCESSORIES

- A. 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.
- B. Sealants:
 - 1. Structural Glazing Sealant: Comply with requirements for structural-sealant- glazed components, as stated elsewhere in the Contract Documents.

2. Use sealants that have a VOC content of 50 grams per liter or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - C. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
 - D. Setting Blocks: Neoprene, 80 to 90 Durometer shore A hardness; minimum 4 inches long, per GANA Glazing Manual.
 - E. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - F. Shims: Provide aluminum shims as required for use beneath neoprene setting blocks to maintain proper alignment of space bar along sight line.
 - G. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
 - H. Edge Protection: Provide continuous aluminum bar stock, size as indicated, with clear anodized finish, adhered to edge of glass with structural silicone sealant, to protect the interlayer of laminated glass from moisture.
- 2.06 GLAZING SURFACE FILMS
- A. Comply with requirements for glazing surface films as stated in Section 08 87 00 - Glazing Surface Films.
- 2.07 FABRICATION OF GLAZING UNITS
- A. Fabricate glazing units in standard sizes indicated. Where non-standard sizes are indicated, fabricate glazing units in sizes required to fit openings indicated:
 1. Provide units with edge and face clearances, surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
 - C. Exposed glass edges and corners: Grind smooth and polish.
 - D. Butt jointed glass panels: Grind smooth and polish glass edges.
- 2.08 SMOKE BAFFLE ASSEMBLIES
- A. Description: Exposed aluminum soffit-mounted shoe with concealed vinyl cap rail for glass, concealed stainless steel bolt through glass and glazing grommets and gaskets. Include soffit anchors sized to support imposed loads. Shoe sized to glass thickness indicated.
 - B. Glass-to-Glass Joints: 1/2 wide, filled with CRL Water Clear Silicone Sealant.
 - C. Shoe Finish: Mill finish, unless otherwise indicated.
 - D. Basis of Design: CRL B5B Series Smoke Baffle by C.R. Laurence Architectural Products.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.03 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Contract site and legally dispose of off Contract site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- C. 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.
- D. Provide spacers for glass lites where length plus width is larger than 50 inches:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- E. 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.
- F. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.04 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. 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. Do not remove release paper from tape until right before each glazing unit is installed.
- D. Apply heel bead of elastomeric sealant.

3.05 STRUCTURAL SILICONE GLAZING

- A. Clean, prime and mask at structural silicone joints during the same work day on which the silicone is applied.
- B. Temporarily clamp glass during cure of structural silicone. After sufficient cure, remove clamps and fill any gaps in silicone.
- C. Mask glass and aluminum during application of structural silicone. Remove masking immediately after tooling sealant.
- D. Seal exterior flush joints at structural silicone conditions with silicone sealant specified herein.
- E. Do not apply structural silicone to edges of insulating glass units, or to edges of laminated glass units. Do not adhere to, or place against, the edge of laminated glass unit interlayer, sealants used as weather seals.

3.06 GRAFFITI RESISTANT FILM APPLICATION

- A. Comply with written film manufacture's requirements for water and graffiti repellents film installations, as stated elsewhere in the Contract Documents.

3.07 SMOKE BAFFLE INSTALLATION

- A. Install in accordance with Shop Drawings and manufacturer's written instructions.
- B. Tool seal glass-to-glass joints and vertical perimeter joints with sealant to uniform profile.

3.08 CLEANING AND PROTECTION

- A. 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.
- B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- C. Wash glass on both exposed surfaces in each area of Contract not more than four (4) days before date scheduled for inspections that establish date of Acceptance. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

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SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for the following:
 - a. Metal stud wall framing for gwb assemblies.
 - b. Metal channel ceiling framing for gwb ceilings.
 - c. Shaft wall system.
 - d. Fire-rated wall and ceiling assemblies.
 - e. Gypsum wallboard.
 - f. Gypsum Sheathing
 - g. Cementitious backer board.
 - h. Joint treatment and accessories.
 - i. Acoustic insulation and sealant.
 - j. Delegated design of framing systems.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents:

1. American National Standards Institute (ANSI):
 - a. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.
 - b. ANSI A118.9 - American National Standard Test Methods and Specifications for Cementitious Backer Board.
2. American Society for Testing and Materials International (ASTM):
 - a. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - b. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.
 - c. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

- d. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - e. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
 - f. ASTM C665-12 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction.
 - g. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - h. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
 - i. ASTM C919 Standard Practice for Use of Sealants in Acoustical Applications.
 - j. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - k. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - l. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - m. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
 - n. ASTM C1658/C1658M – Standard Specification for Glass Mat Gypsum Panels.
 - o. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - p. ASTM E72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 - q. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - r. ASTM E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
 - s. ASTM E1190 - Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
3. Gypsum Association (GA):
- a. GA-214 – Recommended Levels of Gypsum Board Finish.
 - b. GA-216 - Application and Finishing of Gypsum Panel Products.
 - c. GA-219 - Frame Opening Details.
 - d. GA-226 - Application of Gypsum Board to Form Curved Surfaces.
 - e. GA-600 - Fire Resistance Design Manual.

1.03 SUBMITTALS

A. Submit:

1. Shop Drawings: Indicate special details associated with fireproofing, acoustic seals, and other unique details. Show size, gauge, and spacing of studs used to comply with specified requirements for steel framing and show all control joints as indicated or required in accordance with ASTM C840.
2. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system. Include all fire rated assembly test pages.
3. Engineering: for Delegated-Design Submittals include analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements. Provide ICC reports on all fasteners.
4. Provide manufacturer's data or engineering calculations on spans, deflection, attachment methods, and bracing, and indicate compliance with code. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
5. LEED Submittals:
 - a. Where LEED certification is required by the project, submit the same documentation for approval as required by GBCI as a project submittal. Highlight the relevant LEED information.
 - b. LEED documentation is to be submitted separately and titled LEED SUBMITTAL.
 - c. Building Product Disclosure and Optimization credit data: Submit data to support the LEED SUBMITTAL.

B. Transmit:

1. Test Reports: For all stud framing products that do not comply with ASTM C 645 or C 754, provide independent laboratory reports showing maximum stud heights at required spacing and deflections.

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- B. Single Source Responsibility for Finishing Materials: Obtain finishing materials from the same manufacturer that supplies gypsum board and other panel products.
- C. Perform all work of this Section in accordance with ASTM C 840.
- D. Applicator Qualifications: Company specializing in performing gypsum board application and finishing, with minimum three years of documented experience.
- E. Mock-Up:
 1. In advance of the drywall work, construct mock-up of gypsum panel wall/ceiling assemblies to establish finished appearance expectations of the selected finishing and paint system:

- a. Locate mock-up(s) as directed by Resident Engineer for representative conditions of a level 3, 4, and 5 finish.
 - b. Apply paint finishes as specified in Section 09 90 00 -0 Painting and Coatings.
2. The mock-up must be representative of the actual project wall and ceiling configuration(s) and finished lighting to be used in the building.
3. Include examples of finished horizontal and vertical panel joints, wall to ceiling transition condition, control joints, edge conditions at window or door frame, and embedded items such as lighting and wall penetrations such as pipe or conduit.
4. Maintain accepted mock-ups for the duration of construction as the standard for expected quality of work.
5. Accepted mock-ups may remain as part of the completed work if undisturbed at time of substantial completion.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, identification, storage and handling shall be in accordance with the requirements of ASTM C754.
- B. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- C. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.
- D. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.06 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.
- B. Ventilation: Ventilate building spaces, to the extent required, for drying joint treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Completed assemblies to comply with ASTM C840 and GA-216.
- B. Fire Test Response Characteristics: Where fire-rated gypsum board assemblies are indicated, provide materials and construction identical to those of assemblies tested for fire resistance in accordance with ASTM E 119 by an Independent Testing Laboratory agency acceptable to the authorities having jurisdiction.
- C. Fire Resistance Ratings: As indicated by reference to GA file numbers in GA-600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or

in the listing of another Independent Testing Laboratory acceptable to authorities having jurisdiction:

1. Regulatory Requirements:
 - a. Conform to applicable code for fire-rated assemblies as follows:
 - 1) Fire-Rated Partitions: Listed assembly by UL or GA with required hour ratings as indicated on Drawings.
 - 2) Head of Fire-Rated Partitions: Listed assembly by UL or GA with required hour ratings as indicated on Drawings.

2.02 MANUFACTURERS

- A. Glass Mat Gypsum Board, Gypsum Sheathing; Moisture **and Mold**-Resistant Sheathing:
 1. Georgia-Pacific Gypsum Corporation.
 2. National Gypsum Company.
 3. United States Gypsum Company.
 4. CertainTeed.
 5. Manufacturers not otherwise listed, subject to compliance with requirements as required by proprietary fire-rated or acoustical assemblies as indicated on the contract documents.
- B. Cementitious Backer Board:
 1. Custom Building Products.
 2. James Hardie.
 3. United States Gypsum Company.
- C. Metal Support Systems:
 1. Scafco.
 2. Cemco.
 3. ClarkDietrich.
 4. Manufacturers not otherwise listed, subject to compliance with requirements as required by proprietary fire-rated or acoustical assemblies as indicated on the contract documents.

2.03 MATERIALS

- A. Metal Framing:
 1. General: Provide steel framing members complying with the following minimum requirements:
 - a. Performance Requirements: Select steel studs and all other members in accordance with the manufacturer's standard load tables and following design pressures and deflections:
 - 1) At all partitions: 1/360 at 10 pounds per square foot.

- 2) At suspended and furred ceilings: 1/240 per 10 pounds per square foot.
 - b. Protective Coating: G40 hot-dip galvanized coating in accordance with ASTM A653.
2. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the conditions indicated.
- a. Exception: The minimum metal thickness and section properties requirements of ASTM C645 are waived provided steel of 40,000 pounds per square inch minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E72 using assemblies specified by ASTM C754.
 - b. Steel Studs and Runners: ASTM C645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch-wide minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
 - 1) Thickness: As required to comply with performance requirements for horizontal deflection:
 - a) Depth: ~~As detailed~~ Match existing.
 - c. Steel Rigid Furring Channels: ASTM C645, hat-shaped, depth and minimum thickness of base (uncoated) metal as follows:
 - 1) Depth: 7/8 inch.
 - 2) Thickness: 0.0179 inch, unless otherwise indicated.
 - d. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C645, minimum thickness of base (uncoated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.
 - e. Z-Furring Members: Manufacturer's standard Z-shaped furring members with slotted or non-slotted web, fabricated from steel sheet complying with ASTM A653 or ASTM A568; with a minimum base metal (uncoated) thickness of 25 GA at interior non load bearing locations, face flange of 1-1/4-inch, wall-attachment flange of 7/8 inch, and of depth required to fit insulation thickness indicated.
 - f. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.
3. Sheet Metal Backing/Strapping: Continuous sheet material fabricated from corrosion-resistant steel sheet in widths complying with ASTM C645.
- a. Strapping: Provide 16-gauge x 2 inches width strapping at locations indicated on Drawings.

- b. Backing: Behind all cabinetry and shelving, provide 16-gauge sheet metal backing, sized to match extent of cabinetry or shelving, inside of walls screwed directly on steel studs before gypsum wallboard is installed. Ensure flat gypsum installation as required by ANSI A108-A4.8. Use "MantisGrip" backing clips where appropriate. www.mantisgrip.com
- 4. Typical Framing Components:
 - a. Studs: "C" shaped with flat or formed webs.
 - b. Runners: U shaped, sized to match studs.
 - c. Ceiling Channels: C shaped.
 - d. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - e. Deflection Track: Manufacturer's deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads.
- 5. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- 6. Framing for Suspended and Furred Wallboard Ceilings: Type and size as specified in ASTM C754 for spacing required.
- 7. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short.

B. Gypsum Board

- 1. GWB-1: 5/8 inch thick with fiberglass mat laminated to both sides and with manufacturer's standard edges. Comply with ASTM C1658 and ASTM C1177/C1177M when used as exterior sheathing.
- 2. GWB-2: Same as GWB-1 except fire rated. Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
- 3. GWB-3: **Type X** fiberglass-mat faced moisture and mold-resistant gypsum wallboard as defined in ASTM C1396/C1396M and complying with ASTM C1658. Sizes to minimize joints in place. Mold resistance: ASTM D3273, score of 10. Thickness as indicated on drawings.
- 4. GWB-4: Gypsum Shaftwall or Coreboard: ASTM C1396/C1396M; Type X or Type C core as required by indicated tested assembly; sizes to minimize joints in place; 1 inch thick; square, tongue and groove, or double beveled edges, ends square cut.
- 5. CBB-1: Cementitious Backerboard Substrate for Ceramic Wall Tile and Interior Acoustical Cement Plastering:
 - a. Backerboard: ANSI A118.9; ASTM C1325 High density, cementitious, glass fiber reinforced. 5/8" thick unless noted otherwise.
 - b. Mesh Tape: 2-inch wide self-adhesive, coated fiberglass mesh tape for joints and corners.

2.04 ACCESSORIES

A. Sound Attenuation Blankets:

1. Walls: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of glass or slag described below with thermosetting resins to comply with ASTM C665 for Type I (blankets without membrane facing):
 - a. Product: Provide one of the following:
 - 1) Rockwool (Acoustical Fire Batts) AFB Rockwool International.
 - 2) SAFB (Sound Attenuation Fire Blankets) by Thermafiber division of Owens Corning, Co.
2. Above Ceilings: Semi-Rigid Mineral Wool: ASTM C612, Type IVA, faced on one side with black facing, and with maximum flame-spread and smoke developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics:
 - a. Product: QuietFiber by Acoustiblok, or approved equal product by Rockwool, Owens Corning.

B. Acoustic Sealant: Non-hardening, non-skinning, non-sag, non-staining, paintable latex sealant, for use in conjunction with gypsum board, and complying with ASTM C919, ASTM C834, ASTM E90, ASTM E84 Class A and the following:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AC-20 FTR Acoustical and Insulation Sealant, Pecora Corp.
 - b. SHEETROCK Acoustical Sealant, United States Gyp Co.
 - c. Or approved equal.
2. At fire-rated partitions, sealant must be approved for use in the Listed UL or GA Head-of-Wall joint system, in accordance with Article 2.1.

C. Corner Beads, Edge Trim, and Control Joints: Galvanized steel, or plastic, complying with ASTM C1047. Sheet steel zinc-coated by hot-dip process:

1. Shapes indicated below by reference to Fig. 1 designations in ASTM C1047:
 - a. Provide metal cornerbead on outside corners, unless otherwise indicated on Drawings.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim unless otherwise indicated.
 - c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
 - d. One-piece control joint formed with V-shaped slot, with removable strip covering slot opening.

D. Aluminum Accessories: Where indicated, provide manufacturer's standard extruded aluminum accessories of profile indicated or referenced by manufacturer's product designations, complying with the following requirements:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of finish indicated and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B221 for alloy and temper 6063-T5.
 2. Class II Clear-Anodized Finish: AA-C12C22A3 1 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: etched, medium matte; Anodic.
- E. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions:
1. Joint Tape: Provide paper reinforcing tape, unless otherwise indicated.
 2. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated:
 - a. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.
 - b. For pre-filling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.
 - c. For filling joints and treating fasteners of water-resistant gypsum ~~backing board behind base for ceramic tile~~, use formulation recommended by the gypsum board manufacturer for this purpose.
 - d. For topping compound, use sandable formulation.
 3. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use:
 - a. Ready-Mixed Formulation: Factory-mixed product.
 - b. Job-Mixed Formulation: Powder product for mixing with water at Project site.
 - c. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
 - d. Topping compound formulated for fill (second) and finish (third) coats.
- F. Screws: ASTM C1002; self-drilling type unless otherwise noted. Provide corrosion resistant coated steel drill screws in accordance with manufacturer recommendations at all exterior and wet interior locations.
- G. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum panels.
- H. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to steel framing.
- I. Anchorage to Substrate: Corrosion resistant tie wire, nails, screws, fasteners, sealants and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- J. Cast-In-Place and Post-Installed Anchors in Concrete: Chemical, Expansion, or Cast in place anchors, fabricated from corrosion-resistant materials, with holes or loops for attaching hanger wires, and with capability to sustain, without failure, a load equal to

5 times that imposed by ceiling construction, as determined from testing in accordance with ASTM E488 conducted by an Independent Testing Laboratory.

- K. Powder-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 hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190 conducted by an Independent Testing Laboratory.
- L. Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft temper. 0.1620- inch (8 gauge) diameter.
- M. Hanger Rods: Mild steel and zinc-coated or protected with rust-inhibitive paint.
- N. Flat Hangers: Mild steel and zinc-coated or protected with rust-inhibitive paint.
- O. Angle-Type Hangers: Angles with legs not less than 7/8 inch wide, formed from 0.0635-inch-thick galvanized steel sheet complying with ASTM A446 Coating Designation 090, with bolted connections and 5/16-inch-diameter bolts.
- P. Elastomeric Spray-Applied Membrane: At fire-rated partitions, membrane must be approved for use in the Listed UL or GA Head-of-Wall joint system, in accordance with Article 2.1:
 - 1. CP 672 Fire Spray by Hilti Construction Chemicals.
 - 2. Metacaulk 1200 and Biostop 750 by Rectorseal.
 - 3. SpecSeal AS 200 Elastomeric Spray, by Specified Technologies, Inc.

2.05 FINISHES

- A. Gypsum Board:
 - 1. Finish gypsum board to the Levels shown in the schedule at the end of Part 3 for different applications. Finish Levels to comply with GA 214 "Recommended Levels of Gypsum Board Finish".
 - 2. Finish water-resistant gypsum backing board forming substrate for ceramic tile to comply with ASTM C840 and board manufacturer's directions for treatment of joints behind tile.
 - 3. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes:
 - a. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 4. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of

assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected:

1. Notify Resident Engineer 7 days in advance of date and time when Work, or part of Work, will be ready for ceiling framing observation.

3.02 PREPARATION

A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings:

1. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

3.03 METAL FRAMING INSTALLATION

A. Shaft Wall:

1. General: Install gypsum board shaft-wall assemblies to comply with performance and other requirements indicated as well as with manufacturer's installation instructions and the following:
 - a. ASTM C754 for installing steel framing.
2. Do not bridge building expansion joints with shaft-wall assemblies; frame both sides of joints with furring and other support as indicated.
3. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing:
 - a. Support elevator hoistway door frames independently of shaft-wall framing assemblies or reinforce assemblies according to assembly manufacturer's instructions.
 - b. Where handrails are indicated for direct attachment to gypsum board shaft-wall assemblies, provide not less than a 0.0341-inch-thick by 4-inch-wide galvanized steel reinforcement strip, accurately positioned and secured behind not less than 1 gypsum board face layer of 1/2-inch or 5/8-inch thickness.
4. Coordinate gypsum board shaft-wall construction with fireproofing applied to structural elements so both remain complete and undamaged. Patch or replace sprayed-on fireproofing removed or damaged during the installation of shaft-wall assemblies to comply with requirements specified in Section 07 81 00 - Applied Fire Protection.
5. Integrate stair hanger rods with gypsum board shaft-wall assemblies where indicated (and where possible) by locating cavity of assemblies where required to enclose rods.
6. At penetrations in shaft wall, maintain fire-resistance rating of entire shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

7. Isolate shaft-wall assemblies from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details indicated on Drawings.
 8. Seal gypsum board shaft-walls at perimeter of each section that abuts other work and at joints and penetrations within each section. Install acoustical sealant to withstand dislocation by air pressure differential between shaft and external spaces; comply with manufacturer's instructions and ASTM C919.
 9. Shaft Wall Framing: Comply with manufacturer's installation instructions:
 - a. Install studs at spacing required to meet performance requirements.
- B. Metal Framing:
1. Metal Framing General: **Replace all corroded or damaged metal framing matching the existing profiles and spacings.** Comply with ASTM C754 and manufacturer's instructions, ASTM C754 and with ASTM C840 requirements that apply to framing installation.
 - a. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none are available, with "Gypsum Construction Handbook" published by United States Gypsum Co.
 - b. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings:
 - 1) Where building structure abuts ceiling perimeter or penetrates ceiling.
 - 2) Where partition framing and wall furring abut structure except at floor.
 - a) Provide slip- or cushioned-type joints as detailed to attain lateral support and avoid axial loading.
 - 3) Install elastomeric spray-applied sealant and mineral wool deck flute packing as required at deflection track in accordance with manufacturer's instructions.
 - c. Do not bridge building expansion and control joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.
 - d. Provide anchorage bracing and support designed to meet structural seismic requirements of relevant building code.
 2. Suspended Ceilings and Soffits:
 - a. Suspend ceiling hangers from building structural members and 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 ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.

- 2) Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and requirements of AHJ.
 - 3) Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, screw eyes, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 4) Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, screw eyes, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 5) Do not support ceilings directly from permanent metal forms. Furnish cast-in- place hanger inserts that extend through forms.
 - 6) Do not attach hangers to steel deck tabs.
 - 7) Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 8) Do not connect or suspend steel framing from ducts, pipes or conduit.
- b. Sway-brace suspended steel framing with hangers used for support.
 - c. Install suspended steel framing components in sizes and at spacing indicated but not less than that required by the referenced steel framing installation standard:
 - 1) Wire Hangers: 4 feet on center.
 - 2) Carrying Channels (Main Runners): 1-1/2 inch, 4 feet on center.
 - 3) Rigid Furring Channels (Furring Members): 16 inches on center.
 - d. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring members or grid suspension members are level to within 1/8 inch in 12 feet as measured both lengthwise on each member and transversely between parallel members.
 - e. Wire-tie or clip furring members to main runners and to other structural supports as indicated.
 - f. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
 - g. Install bracing as required at exterior locations to resist wind uplift.

3. Framing for Walls and Partitions:
- a. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
 - b. For STC-rated and fire-resistive-rated partitions seal runners (tracks) to floor and underside of roof deck as indicated in the Listed Assembly per Article 2.01.
 - c. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from the plane formed by the faces of adjacent framing.
 - d. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Cut studs 1/2 inch short of full height. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board:
 - 1) For STC-rated and fire-resistive-rated partitions requiring partitions to extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
 - e. Terminate partition framing at suspended ceilings where indicated.
 - f. Install steel studs and furring in sizes and at spacing indicated but not less than that required by the referenced steel framing installation standard to comply with maximum deflection and minimum loading requirements specified.
 - g. Install steel studs so that flanges point in the same direction and so that leading edges or ends of each gypsum board can be attached to open (unsupported) edges of stud flanges first.
 - h. Frame door openings to comply with details indicated, with GA-219, and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs:
 - 1) Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
 - i. Frame openings other than door openings to comply with details indicated or, if none indicated, in same manner as required for door openings. Install framing below sills of openings to match framing required above door heads.
4. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
5. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center:

a. Orientation: Horizontal.

6. Blocking: Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

3.04 GYPSUM BOARD INSTALLATION

A. Comply with ASTM C840 and GA-216. Install to minimize butt end joints, especially in highly visible locations:

1. Gypsum Soffit Board: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.
2. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.
3. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.
4. Install ceiling board panels across framing to minimize the number of abutting end joints and avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member. Do not install water resistant gypsum backing board at ceiling locations.
5. Install wall/~~partition~~ board panels to minimize the number of abutting end joints or avoid them entirely. Stagger abutting end joints not less than one framing member in alternate courses of board. At stairwells and other high walls, install panels horizontally with end abutting joints over studs and staggered.
6. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
7. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position adjoining panels so that tapered edges abut tapered edges, and field-cut edges abut field-cut edges and ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions. Avoid joints at corners of framed openings where possible.
8. Attach gypsum panels to steel studs so that the leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
9. Attach gypsum panels to framing provided at openings and cutouts.
10. Form control joints and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
11. Cover both faces, of steel stud partition framing with gypsum panels in concealed spaces (above ceilings), except in chase walls that are braced internally:
 - a. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 square feet in area.
 - b. Fit gypsum panels around ducts, pipes, and conduits.

12. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
 13. Tolerances:
 - a. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.
- B. Gypsum Board Application Methods:
1. Single-Layer Application: Install gypsum wallboard panels as follows:
 - a. On ceilings, apply gypsum panels prior to wall partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated. Provide firm bearing for all ends and edges.
 - b. On ~~partitions~~ walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints. Provide firm bearing for all ends and edges.
 - c. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 2. Double-Layer Application: Install same gypsum wallboard as scheduled for base layers and for face layers:
 - a. On ceilings, apply base layer prior to applying base layer on walls/partitions; apply face layers in same sequence. Offset face-layer joints at least 10 inches from parallel base-layer joints. Apply base layers at right angles to framing members unless otherwise indicated.
 - b. On partitions/walls, apply base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face layer joints offset at least one stud or furring member with base layer joints. Stagger joints on opposite sides of partitions.
 - c. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 3. Wall Tile Substrates: For substrates indicated to receive thin-set ceramic tile and similar rigid applied wall finishes, comply with the following:
 - a. Install tile backer board to comply with ANSI A108.11.
 4. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:
 - a. Fasten with screws.
 5. Double-Layer Fastening Methods: Apply base layer of gypsum panels and face layer to base layer as follows:
 - a. Fasten both base layers and face layers separately to supports with screws.
 - b. Fasten base layers with screws and face layer with adhesive and supplementary fasteners.
- C. Trim and Accessories:

1. Control Joints: Place control joints consistent with lines of building spaces and as indicated:
 - a. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - b. At exterior soffits, not more than 30 feet apart in both directions.
2. Corner Beads: Install at external corners, using longest practical lengths.
3. Edge Trim: Install at locations where gypsum board abuts dissimilar materials. Install edge trim where edge of gypsum panels would otherwise be exposed or semi-exposed. Provide edge trim type with face flange formed to receive joint compound except where other types are indicated:
 - a. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 - b. Install L-bead where edge trims can only be installed after gypsum panels are installed.

D. Joint Treatment:

1. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated:
 - a. Pre-fill open joints rounded or beveled edges, and damaged areas using setting-type joint compound.
 - b. Apply joint tape over gypsum board joints except those with trim accessories having concealed face flanges not requiring taping to prevent cracks from developing in joint treatment at flange edges.
 - c. Apply joint tape over gypsum board joints and to trim accessories with concealed face flanges as recommended by trim accessory manufacturer and as required to prevent cracks from developing in joint compound at flange edges.

3.05 CLEANING

- A. Promptly remove any residual joint compound from adjacent surfaces.

3.06 PROTECTION

- A. Provide final protection and maintain conditions, in a manner suitable to Installer that ensures gypsum board assemblies remain without damage or deterioration at time of Completion.
- B. Repair or replace GWB damaged during construction to match the quality and appearance of the original finish.

3.07 SCHEDULES

- A. Finish Levels:
 1. Finish gypsum board in scheduled areas in accordance with levels defined in ASTM C840, GA-214 and as scheduled below.

2. Level 1: Above finished ceilings concealed from view, for ceiling plenum areas, and where indicated, unless a higher level of finish is required for fire-resistive-rated assemblies and/or sound-rated assemblies.
3. Level 2: Utility areas and where cementitious backing board panels form substrates for tiling, and where indicated.
4. Level 3: Standard finish level unless otherwise noted.
5. Level 4: To be used at buildings in personnel spaces, including offices and crew facilities.
6. Level 5: Use where recommend by gypsum board manufacturer and GA-214 to achieve satisfactory finish on glass-mat faced gypsum, and where required by wall covering and/or tile manufacturer.
 - a. Level 5 finish is required for office and crew facilities and public lobbies where satisfactory finish results cannot be achieved with a level 4 finish, as determined via mock-up.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Requirements for the following:
 - a. Metal partition, ceiling, and soffit framing for assemblies not containing gypsum board.
 - b. Interior suspension systems for non-gwb ceilings.
 - c. Blocking and backing panels.
 - d. Furring channels and supports for non-gwb finishes.
- B. This section does not include:
1. Gypsum board assemblies.
 2. Fire-rated assemblies and shaft walls.
 3. Load-bearing framing.

1.02 REFERENCES

- A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel wire.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C635/635M - Standard Specification for Manufacturer, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- H. ASTM E413 - Classification for Rating Sound Insulation.
- I. ASTM E580 - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

1.03 SUBMITTALS

- A. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, currently licensed in the State of Washington, who is responsible for their preparation.
- B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- C. LEED Submittals:
 - 1. Where LEED certification is required by the project, submit the same documentation for approval as required by GBCI as a project submittal. Highlight the relevant LEED information.
 - 2. LEED documentation is to be submitted separately and titled LEED SUBMITTAL.
 - 3. Building Product Disclosure and Optimization credit data: Submit data to support the LEED SUBMITTAL.
- D. Shop Drawings:
 - 1. Indicate required flashings, sealing at openings.
 - 2. Indicate acoustic details.
 - 3. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- E. Qualification Data: For Installer and design engineer.
- F. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of documented experience on projects of similar size and complexity.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Perform Work in accordance with ASTM C645.
- B. Coordinate the placement of components to be installed within stud framing system.

- C. Ceiling Assemblies: Coordinate with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
- D. Design and install framing and furring to limit deflection to the following under point loads of 100 lbs. and uniform loads as noted below psf except where required to withstand greater load. (pressurized shafts and stairwells for example):
 - 1. Maximum Deflection of Vertical Assemblies:
 - a. Assemblies spanning single floor: Sustained loads of 5 lbf/sq ft with a maximum mid span deflection of 1:240.
 - b. Assemblies spanning multiple floors: Sustained loads of 7.5 lbf/sq ft with a maximum mid span deflection of 1:240.
 - 2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.
 - 3. Maximum Deflection for assemblies under applied plaster finishes (Portland Cement or Gypsum) and ceramic tile is 1:360. Comply with requirements in ASTM C840 that apply to framing installation for gypsum board assemblies.
 - 4. Use The SSMA Product Technical Information Book to look up the appropriate stud size, spacing and thickness.
- E. Ceiling and Soffit Framing:
 - 1. Seismic Requirements:
 - a. Classification; Confirm to ASTM C635, heavy Duty Classification.
 - b. Code Compliance: FBC, American Society of Civil Engineers ASCE 7 Section 13 and CISC Guidelines.
- F. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.02 MANUFACTURERS

- A. Specification is based on products by members in good standing of the Steel Stud Manufacturer's Association.

2.03 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated. Comply with manufacturer's requirements for height/ span limitations for non-gypsum assemblies:
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated.
 - 2. Protective Coatings: ASTM A653/A653M, G60 and G90, hot-dip galvanized:
 - a. G60, unless noted otherwise.
 - b. G90 at exterior conditions and where indicated on the Drawings.

- B. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Material:
 - a. Typical: ASTM A653/A653M steel sheet, SS Grade 50, with G40/Z120 hot dipped galvanized coating.
 - b. Areas Subject to Moisture: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating. Areas include exterior or non-conditioned space, shower rooms, locker rooms or other locations subject to regular wetting or high humidity.
- C. Studs and Tracks: ASTM C645:
1. Steel Studs and Tracks:
 - a. Minimum Base-Metal Thickness: 0.0329 inch.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 2. Deflection Track: Steel sheet top track manufactured to in accordance with STC details on the Drawings and to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above:
 - a. In thicknesses matching those indicated for studs and in widths to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated:
1. Minimum Base-Metal Thickness: 0.0179 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Metal Thickness: 0.0179 inch.
 2. Depth: As indicated on Drawings.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.04 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Wire Hangers: ASTM A641/A641M, ASTM 636, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

- C. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
- D. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Tracks: ASTM C645:
 - a. Minimum Base-Metal Thickness: 0.0179 inch
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep or as indicated on the drawings:
 - a. Minimum Base-Metal Thickness: 0.0179 inch.
- E. Grid Suspension System for Ceilings: ASTM C635 ASTM C636, ASTM E580, direct-hung system composed of main beams and cross-furring members that interlock.
- F. Blocking and backing panels:
 - 1. Sheet Metal Backing (Blocking): 0.036 inch thick, galvanized. 4-inch minimum width
 - 2. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
 - 3. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
 - 4. Specifically, provide non-structural framing and blocking at the following locations:
 - a. Cabinets and shelf supports.
 - b. Wall brackets.
 - c. Handrails.
 - d. Grab bars.
 - e. Towel and bath accessories.
 - f. Wall-mounted door stops.
 - g. Whiteboards and marker boards.
 - h. Wall paneling and trim.
 - i. Joints of rigid wall coverings that occur between studs.

2.05 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 - 2. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that rough-in utilities are in proper location.
- B. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 INSTALLATION OF STUD FRAMING

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Comply with requirements of ASTM C754.
- C. Extend partition framing to structure unless noted otherwise:
 - 1. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated.
 - 2. Place two beads of acoustic sealant (one on either side) between runners and substrate, studs and adjacent construction.
 - 3. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
 - 4. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- F. Backing and Blocking: Use steel channels or flat sheets secured to studs minimum 4 inch wide. Provide blocking for support of all wall hung items and equipment.
 - 1. Use sheet metal backing for reinforcement of 16 gauge minimum.
- G. Install supplementary framing and bracing at openings and terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of fixture manufacturer.
- H. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement:
 - 1. Where edges of suspended ceilings abut building structure at ceiling perimeters and at penetrations of structural elements.
 - 2. Where partition and wall framing abuts overhead structure.

3. Where studs are installed directly against exterior walls of masonry or concrete, install asphalt felt strips between studs and wall.

3.03 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C635, ASTM C636, and ASTM E580.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Acoustical sealant may be used in place of asphalt felt strips between the interior studs and exterior CMU or concrete walls.
- E. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- F. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- G. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- H. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- I. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24-inches past each opening.
- J. Laterally brace suspension system:
 1. Sway-brace suspension systems with hangers used for support.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.
- C. Level ceiling to a tolerance of 1/1200. For tilted ceilings maintain this tolerance as a "flatness" tolerance.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION

SECTION 09 91 24
INTERIOR PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.04 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

- A. Subject to compliance with requirements, available products from the following manufacturers may be incorporated into the Work include, but are not limited to, the following:
 - 1. Basis of Design: Sherwin Williams.
 - 2. Rust-Oleum/ Benjamin Moore.

2.02 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another, and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors: Match existing (interior of elevator shaft).

2.03 PRIMERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Primer, latex, for wood, MPI #39.
 - a. Basis of Design: Sherwin-Williams/ PrepRite ProBlock.
 - 2. Primer sealer, latex, MPI #50.
 - a. Basis of Design: Sherwin-Williams/ Promar 200 Zero VOC.
 - 3. Primer, alkyd, MPI #79.
 - a. Basis of Design: Sherwin-Williams/ Kem Bond HS.
 - 4. Primer, Rust-Inhibitive, Water Based: MPI #107.
 - a. Basis of Design: Sherwin-Williams/ Pro-Cryl Universal Primer.
 - 5. Primer, galvanized, water based, MPI #134.
 - a. Basis of Design: Sherwin-Williams/ Pro-Cryl Universal Primer.

2.04 PAINTS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alkyd, (Gloss Level 6), MPI #9.
 - a. Basis of Design: Sherwin-Williams/ Seaguard 1000 Marine Enamel.
 - 2. Latex, (Gloss Level 3), MPI #52.
 - a. Basis of Design: Sherwin-Williams/ Promar 200 Zero VOC.

3. Latex, (Gloss Level 6): MPI #154.
 - a. Basis of Design: Sherwin-Williams/ Pro Industrial, DTM Acrylic.
4. Latex, (Gloss Level 6): MPI #164.
 - a. Basis of Design: Sherwin-Williams/ Pro Industrial, DTM Acrylic.

PART 3 - EXECUTION

3.01 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: 12 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.

3.02 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 re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 1. Field Priming: SSPC-SP 3, "Power Tool Cleaning."

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 1. Use applicators and techniques suited for paint and substrate indicated.

2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 3. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.

3.04 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.05 PAINTING SCHEDULE

A. Gypsum Board Substrates:

1. Latex over Latex Sealer System MPI INT 9.2A:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, matching top coat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

B. Steel Substrates:

1. Water- Based Light Industrial Coating System over Epoxy Primer System, MPI INT 5.1B.
 - a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
 - b. Intermediate Coat: Light-industrial coating, water based, matching topcoat.
 - c. Topcoat: Light-industrial coating, water based, (Gloss Level 6), MPI #154.

END OF SECTION

Div 22

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SECTION 22 05 00**COMMON WORK RESULTS FOR PLUMBING****PART 1 - GENERAL****1.01 SUMMARY****A. Section includes:**

1. Requirements for materials and installation common to most piping systems including dielectric fittings, mechanical sleeve seals, sleeves, escutcheons, grout, equipment, concrete bases, and supports and anchorages.

1.02 REFERENCES**A. This Section incorporates by reference the latest revisions of the following documents:**

1. American Society of Mechanical Engineers (ASME):
 - a. ASME B1.20.1 Pipe Threads, General Purpose (Inch).
2. ASTM International (ASTM):
 - a. ASTM B32 Standard Specification for Solder Metal.
 - b. ASTM B813 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
 - c. ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - d. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - e. ASTM D2261 Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine).
3. American Welding Society (AWS):
 - a. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
 - b. AWS D1.1 Errata for Structural Welding Code – Steel.
 - c. AWS D10.12 Guide for Welding Mild Steel Pipe.

B. Definitions:

1. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
2. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

3. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
4. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
5. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters

1.03 SUBMITTALS

A. Submit:

1. Provide as-built drawings of all building plans in accordance to Division 01 As-Built Documents specification. As-Built drawings shall include as a minimum the location and performance data on each piece of equipment, general configuration of pipe distribution system, including sizes, and water design flow rates of the actual installation. As-Built drawings shall also incorporate any mechanical work which deviates from the contract drawings, including changes resulting from addenda, Requests for Information, and Change Orders. Neatly draft changes on clean "hard copy" drawings to show the work clearly in the actual locations as built.
 - a. Operating Instructions:
 - 1) Provide operating and maintenance instructions in accordance with Division 01 Operation and Maintenance Data specification. The training of the appropriate maintenance staff for each equipment type and/or system shall include, as a minimum, the following.
 - 2) System/Equipment overview (what it is, what it does and which other systems and/or equipment does it interface with).
 - 3) Review of the available operations and maintenance (O&M) materials in accordance with Division 01 Operation and Maintenance Data specification.
 - 4) Review of the Record Drawings on the subject system/equipment, including valve schedules and zone distribution.
 - 5) Hands-on demonstration of all normal maintenance procedures, normal operating modes, and all emergency shutdown and startup procedures.

B. Transmit:

1. Drawings:
 - a. Drawings are diagrammatic, indicating the general arrangement of systems and work. Examine the architectural drawings for exact location of fixtures and equipment. Where they are not definitely located, obtain this information from the Resident Engineer.
 - 1) Follow drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom. If space conditions appear inadequate, notify the Resident Engineer before proceeding with the work.

Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.

2. Product Data: For each type of product indicated.
3. Emergency Tunnel Ventilation System Equipment, sign schedule and layout drawings.
4. Documentation.

1.04 QUALITY ASSURANCE

A. Material and Work:

1. Materials and equipment required for the work shall be new and shall be furnished, delivered, erected, installed, connected, and finished in every detail; and shall be selected and arranged to fit properly into the building spaces. Where no specific kind or quality of material is given, an article as approved by the Resident Engineer shall be provided.
2. Furnish the services of an experienced superintendent, who shall be constantly in charge of the work.

B. Coordination:

1. Provide control and electrical wiring details including power supply connections for any dry systems requiring power and control or any electrically activated valves that require interface with control systems.
2. Drawings are diagrammatic, indicating the general arrangement of systems and work. Examine the architectural drawings for exact location of fixtures and equipment. Where they are not definitely located, obtain this information from the Resident Engineer:
 - a. Follow drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom. If space conditions appear inadequate, notify the Resident Engineer before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.

C. Cooperation with other trades:

1. Give full cooperation to other trades and furnish in writing to other trades, with copies to the Resident Engineer, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
2. Plumbing contractor must inspect and accept the installation work area and furnish in writing to the prime contractor with copies to Resident Engineer prior to starting the installation work.
3. Where plumbing work will be installed in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. If work is installed before coordinating with other trades, or if it causes any interference with work of other trades, make the necessary changes in the work to correct the conditions and bear all costs.

4. Furnish to other trades necessary templates, patterns, setting drawings and shop details for the proper installation of work and for coordinating adjacent work. This includes participation and support of any Building Information Modeling efforts associated with this contract.

D. Record Documentation:

1. As-built drawings shall include as a minimum the location and performance data on each piece of equipment, general configuration of pipe distribution system, including sizes, and water design flow rates of the actual installation. As-built drawings shall also incorporate any mechanical work which deviates from the contract drawings, including changes resulting from addenda, Requests for Information, and Change Orders. Neatly draft changes on clean "hard copy" drawings to show the work clearly in the actual locations as built.

E. Operating Instructions:

1. Provide operating and maintenance instructions in accordance with Specification Section 01 78 23 Operation and Maintenance Data
 - a. System/Equipment overview (what it is, what it does and which other systems and/or equipment does it interface with).
 - b. Review of the available operations and maintenance (O&M) materials in accordance with Specification Section 01 78 23 Operation and Maintenance Data.
 - c. Review of the Record Drawings on the subject system/equipment, including valve schedules and zone distribution.
 - d. Hands-on demonstration of all normal maintenance procedures, normal operating modes, and all emergency shutdown and startup procedures.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver pipes and tubes 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.
- B. Store plastics pipes away from direct sunlight. Support to prevent sagging and bending.
- C. Accessibility:
 1. Install the work with adequate clearances throughout the project, including being responsible for the sufficiency of the size of shafts, chases, double partitions, and suspended ceilings. Cooperate with other trades where work is in the same space. Such spaces and clearances shall be kept to the minimum size required.
 2. Locate all equipment that must be serviced, operated, or maintained in fully accessible positions.
 3. The Fire Protection Subcontractor shall provide the General Contractor the exact locations of access panels for each concealed valve, or other device requiring service. Access panels will be provided and installed by the General Contractor and as specified in the other divisions of the specifications. Submit locations of these panels to the General Contractor in sufficient time to be installed in the normal course of work.

1.06 PROJECT CONDITIONS

A. Cutting and patching:

1. Provide drilling, coring, cutting, and patching necessary to install the work specified in this division. Patching shall match adjacent surfaces.
2. No structural members shall be cut without the approval of the Resident Engineer, and cutting shall be done in a manner directed by them. Do not damage or endanger any portion of the project or work of the Owner or any other separate contractor by drilling, coring, cutting, patching, excavating, and backfilling.
3. Inform the General Contractor and other subcontractors affected of requirements for cutting and patching.

B. Boxes, Sleeves and Chases:

1. Inform the General Contractor of requirements for boxes, sleeves, and chases. The General Contractor shall set boxes, sleeves, and chases. Furnish General Contractor with the boxes and sleeves and be responsible for informing General Contractor of required location.

1.07 WARRANTY

- A. All work, materials, and equipment to be free from defects as required in Division 00 Procurement and Contracting Requirements.
- B. The warranty disregards shorter time limits by any manufacturer of equipment provided.
- C. Make all necessary adjustments and corrections during first year of operation. The fact that the Resident Engineer was present during any construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.

PART 2 - PRODUCTS

2.01 MANUFACTURED PRODUCTS

A. Joining Materials:

1. Manufacturers:
 - a. Capital Manufacturing Co.
 - b. Central Plastics Company.
 - c. Watts Industries Inc. Water Products Div.
 - d. Zurin Industries, Inc. Wilkins Div.
 - e. Or approved equal.
2. Description:
 - a. Fittings are to be the same size and compatible with the piping to be joined. Pressure rating for fittings shall at least be equal to the piping that is to be joined.

3. Materials:

- a. Unless indicated otherwise the following shall be used as joining materials for plumbing work:
 - 1) Pipe-Flange Gasket Materials: nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2) See other sections for isolating flange gasket kits.
 - 3) Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
 - 4) Solder Filler Metals: lead-free alloys.
 - 5) Brazing Filler Metals: BCuP Series or BAg1, unless otherwise indicated
 - 6) Solvent Cements for Joining Plastic Piping
 - a) CPVC Piping: ASTM F493
 - b) PVC Piping: ASTM D2564. Include primer according to ASTM F656

B. Dielectric Fittings:

- 1. Description:
 - a. Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- 2. Performance:
 - a. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 degrees F.
 - b. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 degrees F.
 - c. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 300-psig minimum working pressure as required to suit system pressures.
 - d. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degrees F.
 - e. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F.
- 3. Insulating Material:
 - a. Suitable for system fluid, pressure, and temperature.

C. Floor Plates:

- 1. Description:

- a. One-Piece Floor Plates: Cast iron flange with holes for fasteners.
- D. Flexible Expansion Joint:
 - 1. Description for Vent and Roof Drain Pipe Flexible Expansion Joint:
 - a. Flexible loop capable of 4-inches movement in three planes and consisting of two flexible sections of hose and stainless steel braid, two 90-degree bends and one 180-degree return bend with hanger support nut and drain/air release plug. Provide MetraFlex Metraloop or equal.
 - b. Performance:
 - 1) 150 psi rated.
 - 2. Description for Domestic Hot and Cold Water Pipe Flexible Expansion Joint:
 - a. Flexible loop capable of 4-inches movement in three planes and consisting of two flexible sections of bronze hose and braid, two 90-degree bends and one 180-degree return bend with hanger support nut and drain/air release plug. Provide MetraFlex Metraloop or equal.
 - b. Comply with state codes and standards, where applicable, requiring reduced lead content.
 - c. Performance:
 - 1) 150 psi rated at 70 degrees F.
- E. Access Panels:
 - 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. Croker FRP.
 - b. Mifab.
 - 2. Description:
 - a. Manufactured stainless steel access panel to provide access to utilities in walls and ceilings.
 - b. Dimensions: Scheduled.
 - 3. Assembly or Fabrication:
 - a. Continuous hinge with universal latch. Material shall be minimum 16-gauge door and frame and shall be listed for fire rated applications

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Piping Systems:
 - 1. Contract Drawing, 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 Coordination Drawings.

2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
3. 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.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
5. Install piping to permit valve servicing.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Install piping to allow application of insulation, when applicable.
10. Select system components with pressure rating equal to or greater than system operating pressure.
11. Install escutcheons for penetrations of finished walls, ceilings, and floors.
12. Install floor plates for piping penetrations of equipment-room floors. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
13. Verify final equipment locations for roughing-in.
14. Install flexible expansion joints where indicated on drawings and where piping crosses building seismic joints. Install vertical support hanger within 4 pipe diameters on each side of the flexible joints and seismic joint. Brace each hanger longitudinally and transversely. Install vertical support at 180-degree return bend.

B. Equipment:

1. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
3. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
4. Install equipment to allow right of way for piping installed at required slope.

C. Construction:

1. Join pipe and fittings according to the following requirements.
2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly:
 - a. Threaded Joints: 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 unless dry seal threading is specified.
 - 2) Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 4. Soldered Joints: Apply water-flushable flux, unless otherwise indicated, to tube end. Construct joints using lead-free solder alloy.
 5. Brazed Joints: Construct joints using copper-phosphorus brazing filler metal.
 6. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article:
 - a. Damaged Threads: Do not use pipe sections that have cracked or open welds.
 7. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- D. Pipe Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
 4. Underground, Exterior-Wall Penetrations: Install dielectric couplings and isolating flange gaskets for all underground piping connection the above piping. Coordinate locations and installation with corrosion control systems.
 5. Coordinate locations and installation with corrosion control systems.

3.02 CONCRETE BASES

- A. Anchor equipment to concrete base according to equipment manufacturer's written instructions, according to Authority having Jurisdiction Seismic Codes, and Division 03 Anchorage to Concrete Specification
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit with chamfer edges.
 2. Install dowel rods to connect concrete base to concrete floor as shown on structural drawings.
 3. Install Type 304 stainless steel anchors for supporting equipment that extends through concrete base, and anchors into structural concrete floor. Provide dielectric insulation between dissimilar metals.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use minimum 4,000-psi, 28-day compressive-strength concrete.

END OF SECTION

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
1. Requirements for the following:
 - a. Sleeves.
 - b. Stack-sleeve fittings.
 - c. Sleeve-seal systems.
 - d. Sleeve-seal fittings.
 - e. Grout.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
1. ASTM International (ASTM):
 - a. ASTM A53.
 - b. ASTM E84/E814.
 - c. ASTM A377.
 - d. ASTM A-653.
 - e. ASTM A-888.
 - f. ASTM C1107.
 - g. ASME B36.10.
 2. Underwriters Lab (UL):
 - a. UL (FRD) – Fire Resistance Directory.

1.03 SUBMITTALS

- A. Submit:
1. Product Data: For each type of product indicated (Submittals shall be reviewed by Plumbing and Structural EOR for applicability.)

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Sleeves:

1. Cast-Iron Wall Pipe Sleeves: ASTM A377, Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Cast Iron Pipe sleeves: ASTM A-888 Cast Iron pipe with plain ends.
3. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated or equal corrosion inhibitor coating.
4. Galvanized-Steel-Pipe Sleeves: ASTM A53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
5. Galvanized-Steel-Sheet Sleeves: ASTM A653, 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Stack-Sleeve 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. Jay R. Smith Mfg. Co.
 - b. Wade.
 - c. Zurn.
2. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing:
 - a. Underdeck Clamp: Clamping ring with setscrews.

C. Sleeve-Seal 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. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Link-Seal.
 - e. Pipeline Seal and Insulator, Inc.
 - f. Proco Products, Inc.
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

- a. An assembly consisting of a stainless steel frame, a compression mechanism, and insert modules for pipe, duct and tubing.
- b. Comply with F- and T-ratings as required by local codes, code official, and as tested in accordance with ASTM E814 or UL1479.
- c. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- d. Designs should be water and gas tight to 14.5 psi.
- e. Seals shall be asbestos free, lead free, halogen free.
- f. Pressure Plates: Stainless steel.
- g. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

D. Sleeve-Seal 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. Hold Rite.
 - b. Metraflex Company (The).
 - c. Pipeline Seal and Insulator, Inc.
- 2. 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.

E. Grout:

- 1. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- 2. Characteristics: Nonshrink; recommended for interior and exterior applications.
- 3. Design Mix: 5000-psi, 28-day compressive strength.
- 4. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Sleeve Installation:

- 1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls. Provide waterproof flashing through exterior above grade roof.
- 2. 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. Sleeves shall be two inches larger than proposed pipe diameter.
 - a. Sleeves are not required for core-drilled holes.

3. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed:
 - a. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - b. Cut sleeves to length for mounting flush with both surfaces:
 - 1) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - c. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
 4. Install sleeves for pipes passing through interior partitions:
 - a. Cut sleeves to length for mounting flush with both surfaces.
 - b. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - c. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with applicable codes and standards requirements for joint sealants.
 5. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with applicable codes and standards requirements for firestopping.
- B. Stack-Sleeve-Fitting Installation:
1. Install stack-sleeve fittings in new slabs as slabs are constructed:
 - a. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - b. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with applicable codes and standard for flashing.
 - c. Install section of soil pipe to extend sleeve to 2 inches above finished floor level.
 - d. Extend sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - e. Using grout, seal the space around outside of stack-sleeve fittings.
 2. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with applicable codes and standards requirements for firestopping.
- C. Sleeve-Seal-System Installation:
1. Install sleeve-seal systems in sleeves in exterior concrete walls above and below grade and slabs-on-grade at service piping entries into building.
 2. 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. Fire-Barrier Penetrations: Maintain indicated fire rating of wall, floor at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with applicable codes and standards requirements for firestopping.

D. Sleeve-Seal-Fitting Installation:

1. Install sleeve-seal fittings in new walls and slabs as they are constructed.
2. 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.
3. Secure nailing flanges to concrete forms.
4. Using grout, seal the space around outside of sleeve-seal fittings.
5. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with applicable codes and standards requirements for firestopping.

E. Sleeve And Sleeve-Seal Schedule:

1. Use sleeves and sleeve seals for the following piping-penetration applications:
 - a. Concrete structural elements (Not covered elsewhere in sleeve and sleeve-seal schedule):
 - 1) Piping Smaller Than NPS 6: Cast-iron pipe sleeves.
 - 2) Piping NPS 6 and Larger: Cast-iron pipe sleeves.
 - b. Exterior Concrete Walls above Grade:
 - 1) Piping Smaller Than NPS 6: Cast-iron wall pipe sleeves with sleeve-seal system.
 - a) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2) Piping NPS 6 and Larger: Cast-iron wall pipe sleeves with sleeve-seal system.
 - a) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - c. Exterior Concrete Walls below Grade:
 - 1) Piping Smaller Than NPS 6: Cast-iron wall pipe sleeves with sleeve-seal system:
 - a) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

- 2) Piping NPS 6 and Larger: Cast-iron wall pipe sleeves with sleeve-seal system:
 - a) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- d. Concrete Slabs-on-Grade:
 - 1) Piping Smaller Than NPS 6: Cast-iron wall pipe sleeves with sleeve-seal system:
 - a) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2) Piping NPS 6 and Larger: Cast-iron wall pipe sleeves with sleeve-seal system:
 - a) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- e. Concrete Slabs above Grade:
 - 1) Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves Stack-sleeve fittings.
 - 2) Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves Stack-sleeve fittings.
- f. Interior Partitions:
 - 1) Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - 2) Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following general-duty valves:

1. Copper-alloy ball valves
2. Ferrous-alloy butterfly valves
3. Bronze check valves
4. Spring-loaded, lift-disc check valves
5. Bronze gate valves
6. Bronze globe valves
7. Cast-iron globe valves

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents.

1. American Society of Mechanical Engineers (ASME)
 - a. ASME B1.20.1 Pipe Threads, General Purpose (Inch)
 - b. ASME B16.1 Gray Iron Pipe Flanges and Flanged Fittings
 - c. ASME B16.5 Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch
 - d. ASME B16.10 Face to Face and End to End Dimensions of Valves
 - e. ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500
 - f. ASME B16.34 Valves Flanged, Threaded and Welding End
2. American Water Works Association (AWWA)
 - a. AWWA C606 Standard for Grooved and Shouldered Joints
3. National Sanitation Foundation (NSF)
 - a. NSF 61 Drinking Water System Components
4. Manufacturers Standardization Society for the Valve and Fittings Industry (MMS)
 - a. MSS SP-45 Bypass and Drain Connections
 - b. MSS SP-67 Butterfly Valves

- c. MSS SP-70 Gray Iron Gate Valves, Flanged and Threaded Ends
- d. MSS SP-71 Gray Iron Swing Valves, Flanged and Threaded Ends
- e. MSS SP-80 Bronze Gate, Globe, Angle and Check Valves
- f. MSS SP-110 Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.03 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; furnished specialties; and accessories.

1.04 QUALITY ASSURANCE

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria
- B. NSF Compliance: NSF 61 for valve materials for potable-water service

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2, Products, Articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.02 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article herein for applications of valves.
- B. Bronze Valves – NPS 2 and Smaller: Threaded ends, unless otherwise indicated
- C. Ferrous Valves – NPS 2-1/2 and Larger: Flanged ends, unless otherwise indicated
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated
- F. Valve Actuators
 - 1. Handwheel: For valves other than quarter-turn types
 - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves
- G. Extended Valve Stems: On insulated valves
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves

- I. Valve Grooved Ends: AWWA C606
 - 1. Threaded: With threads according to ASME B1.20.1
- J. Valve Bypass and Drain Connections: MSS SP-45

2.03 COPPER-ALLOY BALL VALVES

- A. Available Manufacturers
 - 1. Two-Piece, Copper-Alloy Ball Valves
 - a. Crane Co.; Crane Valve Group; Stockham Div.
 - b. Milwaukee Valve Company
 - c. Watts Industries, Inc.; Water Products Div.
 - 2. Three-Piece, Copper-Alloy Ball Valves
 - a. Crane Co.; Crane Valve Group; Stockham Div.
 - b. Milwaukee Valve Company
 - c. Watts Industries, Inc.; Water Products Div.
- B. Copper-Alloy Ball Valves, General: MSS SP-110
- C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem
- D. Three-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem

2.04 FERROUS-ALLOY BUTTERFLY VALVES

- A. Available Manufacturers
 - 1. Flangeless, Ferrous-Alloy Butterfly Valves
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Stockham Div.
 - c. NIBCO INC.
 - d. Single-Flange, Ferrous-Alloy Butterfly Valves
 - e. American Valve, Inc.
 - f. Crane Co.; Crane Valve Group; Stockham Div.
 - g. NIBCO INC.
 - h. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated

- B. Flangeless, 250-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one- or two-piece stem
- C. Flangeless, 300-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one- or two-piece stem
- D. Single-Flange, 250-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem
- E. Single-Flange, 300-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem

2.05 BRONZE CHECK VALVES

A. Available Manufacturers

- 1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc
 - a. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Stockham Div.
 - c. Walworth Co.
- 2. Type 1, Bronze, Vertical Lift Check Valves with Metal Disc
 - a. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves
 - c. Red-White Valve Corp.
- 3. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc
 - a. Grinnell Corporation
 - b. Kitz Corporation of America
 - c. Milwaukee Valve Company
- 4. Type 3, Bronze, Swing Check Valves with Metal Disc
 - a. Crane Co.; Crane Valve Group
 - b. Crane Co.; Crane Valve Group; Jenkins Valves
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Milwaukee Valve Company
- 5. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc
 - a. Crane Co.; Crane Valve Group; Crane Valves
 - b. Crane Co.; Crane Valve Group; Jenkins Valves
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Bronze Check Valves, General: MSS SP-80

6. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat
7. Type 3, Class 200, Bronze, Swing Check Valves: Bronze body with bronze disc and seat
8. Type 4, Class 200, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat

2.06 SPRING-LOADED, LIFT-DISC CHECK VALVES

A. Available Manufacturers

1. Type I, Wafer Lift-Disc Check Valves
 - a. Mueller Steam Specialty
2. Type II, Compact-Wafer, Lift-Disc Check Valves
 - a. GA Industries, Inc.
 - b. Grinnell Corporation
 - c. Milwaukee Valve Company
 - d. NIBCO INC.
 - e. Valve and Primer Corp.
3. Type III, Globe Lift-Disc Check Valves
 - a. Durabla Fluid Technology, Inc.
 - b. Flomatic Valves
 - c. Grinnell Corporation
 - d. Metraflex Co.
 - e. Milwaukee Valve Company
4. Type IV, Threaded Lift-Disc Check Valves
 - a. Grinnell Corporation
 - b. Metraflex Co.
 - c. Milwaukee Valve Company
 - d. Watts Industries, Inc.; Water Products Div.

- B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat
- C. Type I, Class 250, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges
- D. Type II, Class 250, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle

- E. Type III, Class 250, Globe Lift-Disc Check Valves: Globe style with cast-iron shell and flanged ends
- F. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends

2.07 BRONZE GATE VALVES

- A. Available Manufacturers
 - 1. Type 1, Bronze, Nonrising-Stem Gate Valves
 - a. Crane Co.; Crane Valve Group; Crane Valves
 - b. Crane Co.; Crane Valve Group; Jenkins Valves
 - c. Milwaukee Valve Company
 - d. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves
 - e. Crane Co.; Crane Valve Group; Crane Valves
 - f. Crane Co.; Crane Valve Group; Jenkins Valves
 - g. Milwaukee Valve Company
- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel
- C. Type 1, Class 200, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet
- D. Type 2, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet

2.08 BRONZE GLOBE VALVES

- A. Available Manufacturers
 - 1. Type 1, Bronze Globe Valves with Metal Disc
 - a. Crane Co.; Crane Valve Group; Crane Valves
 - b. Crane Co.; Crane Valve Group; Jenkins Valves
 - c. Milwaukee Valve Company
 - 2. Type 2, Bronze Globe Valves with Nonmetallic Disc
 - a. Crane Co.; Crane Valve Group; Crane Valves
 - b. Crane Co.; Crane Valve Group; Jenkins Valves
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel
- B. Type 2, Class 200, Bronze Globe Valves: Bronze body with PTFE or TFE disc and union-ring bonnet

2.09 CAST-IRON GLOBE VALVES

A. Available Manufacturers

1. Type I, Cast-Iron Globe Valves with Metal Seats
 - a. Crane Co.; Crane Valve Group; Crane Valves
 - b. Crane Co.; Crane Valve Group; Jenkins Valves
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Type I, Class 250, Cast-Iron Globe Valves: Gray-iron body with bronze seats

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball, butterfly, gate, or plug valves
 2. Throttling Service: Angle, ball, butterfly, or globe valves
 3. Pump Discharge: Spring-loaded, lift-disc check valves
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
 1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy
 2. Ball Valves, NPS 2-1/2 and Larger: Class 300, ferrous alloy
 3. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange, 250-psig CWP rating, ferrous alloy, with EPDM liner
 4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 200, bronze
 5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 250, gray iron
 6. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer double-flanged, Class 250 or 300, ferrous alloy
 7. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 200
 8. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 250, cast iron
- D. Sanitary Waste and Storm Drainage Piping: Use the following types of valves:
 1. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy
 2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy
 3. Swing Check Valves, NPS 2 and Smaller: Type 3, Class, bronze

4. Swing Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, gray iron
 5. Gate Valves, NPS 2 and Smaller: Type 1, Class 150, bronze
 6. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, OS&Y, bronze-mounted cast iron
 7. Globe Valves, NPS 2 and Smaller: Type 1, Class 150, bronze
 8. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, cast iron
- E. Select valves, except wafer and flangeless types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: threaded ends
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends
 6. For Steel Piping, NPS 5 and Larger: Flanged ends

3.02 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Contract Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level
 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges
 3. Lift Check Valves: With stem upright and plumb

3.03 JOINT CONSTRUCTION

- A. Refer to Section 22 05 00, Common Work Results for Plumbing, Article 3.04.A, for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.04 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.

3.05 COMMISSIONING

- A. Engage a factory-authorized service representative to train Sound Transit's maintenance personnel to adjust, operate, and maintain General Duty Valves for Plumbing Piping systems and equipment. See commissioning for plumbing in other sections for commissioning requirements pertaining to the work of this Section.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes specifications for the following items:

1. Steel pipe hangers and supports
2. Trapeze pipe hangers
3. Metal framing systems
4. Thermal-hanger shield inserts
5. Fastener systems
6. Equipment supports

1.02 REFERENCES

A. Definitions

1. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

B. Reference Standards: This Section incorporates by reference the latest revisions of the following documents.

1. American National Standards Institute (ANSI)
 - a. B16.3 Malleable Iron Threaded Fittings
 - b. B16.5 Pipe Flanges and Flanged Fittings
 - c. B16.21 Nonmetallic Flat Gaskets for Pipe Flanges
 - d. B31.1 Power Piping
2. American Society of Mechanical Engineers (ASME)
 - a. Boiler and Pressure Vessel Code (BPVC), Section IX, Welding and Brazing Qualifications
3. ASTM International (ASTM)
 - a. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - b. ASTM A105 Standard Specification for Carbon Steel Forgings for Piping Applications
 - c. ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

- d. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - e. ASTM A183 Standard Specification for Carbon Steel Track Bolts and Nuts
 - f. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength
 - g. ASTM A536 Standard Specification for Ductile Iron Castings
 - h. ASTM A563 Standard Specification for Carbons and Alloy Steel Nuts
 - i. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - j. ASTM B16 Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
 - k. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
4. American Welding Society (AWS)
- a. AWS D1.1 Structural Welding Code – Steel
 - b. AWS D1.4 Structural Welding Code--Reinforcing Steel
5. Manufacturers Standardization Society for the Valve and Fittings Industry (MSS)
- a. MSS SP-58 Pipe Hangers and Supports – Materials, Design and Manufacture
 - b. MSS SP-69 Pipe Hangers and Supports – Selection and Applications
 - c. MSS SP-89 Pipe Hangers and Supports – Fabrications and Installation Practices
 - d. MSS SP-90 Guidelines on Terminology for Pipe Hangers and Supports
6. National Fire Protection Association (NFPA)
- a. NFPA 13 Standard for Installation of Sprinkler Systems
 - b. NFPA 14 Installation of Standpipe and Hose Systems
 - c. NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail
7. Uniform Plumbing Code with local amendments (UPC)

1.03 SUBMITTALS/TRANSMITTALS

A. Submittals

- 1. Product data for the following:
 - a. Steel pipe hangers and supports
 - b. Thermal-hanger shield inserts
 - c. Powder-actuated fastener systems

2. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - a. Trapeze Pipe Hangers: Include Product Data for components
 - b. Metal Framing Systems: Include Product Data for components
 - c. Equipment supports
 3. Delegated-Design Submittal: For hangers and supports calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation
- B. Transmittals
1. Welding Certificates: In accordance with welding specification

1.04 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, AWS D1.4, and ASME Boiler and Pressure Vessel Code: Section IX

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In Part 2 Articles herein, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 PERFORMANCE REQUIREMENTS

- A. Hangers and supports shall conform to UPC 2021 including local amendments.
- B. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Design seismic-restraint hangers and supports for piping and equipment per requirements of other sections and obtain approval from authorities having jurisdiction.

2.03 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Article 3.01 herein for locations to use specific hanger and support types.
- B. Available Manufacturers
 1. B-Line Systems, Inc.; a division of Cooper Industries
 2. Grinnell Corp
 3. National Pipe Hanger Corporation

4. Galvanized, Metallic Coatings: All components shall be hot dip galvanized unless otherwise indicated.
 - C. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.
- 2.04 TRAPEZE PIPE HANGERS
- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts. All components shall be hot dip galvanized unless otherwise indicated.
- 2.05 METAL FRAMING SYSTEMS
- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components. Provide approved calculations and details and obtain approval by the Resident Engineer.
 - B. Available Manufacturers
 1. B-Line Systems, Inc.; a division of Cooper Industries
 2. Power-Strut Div.; Tyco International, Ltd.
 3. Coatings: All components shall be hot dip galvanized unless otherwise indicated.
 - C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- 2.06 THERMAL-HANGER SHIELD INSERTS
- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield
 - B. Available Manufacturers
 1. PHS Industries, Inc.
 2. Pipe Shields, Inc.
 3. Rilco Manufacturing Company, Inc.
 4. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C533, Type I calcium silicate or ASTM C552, Type II cellular glass with vapor barrier
 - C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C533, Type I calcium silicate or ASTM C552, Type II cellular glass.
 - D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe
 - E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe
 - F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature
 - G. Coating: All components shall be hot dip galvanized unless otherwise indicated

2.07 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers
 - a. B-Line Systems, Inc.; a division of Cooper Industries
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head
- B. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes with hot-dip galvanized coating.

2.08 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A36/A36M, steel plates, shapes, and bars; hot dip galvanized
- B. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and non-metallic grout; suitable for interior and exterior applications
 - 1. Properties: Non-staining, non-corrosive, and non-gaseous
 - 2. Design Mix: 5,000-psi, 28-day compressive strength

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 non-metallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. 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 non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation

4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary
- G. 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 20
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps
- H. 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 degrees F piping installations
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large
 6. C-Clamps (MSS Type 23): For structural shapes
 7. 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 pounds
 - b. Medium (MSS Type 32): 1500 pounds
 - c. Heavy (MSS Type 33): 3000 pounds

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required
- J. 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
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Steel 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 building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A36/A36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- E. Fastener System Installation: Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes. Submit calculations and details with the approval of the Resident Engineer.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 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 according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inches thick
 - b. NPS 4: 12 inches long and 0.06 inches thick
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inches thick
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inches thick
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inches thick

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 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 smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and 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 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 contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.06 PAINTING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.
- B. Touch Up: 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.

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes specifications for the following:

1. Isolation pads
2. Isolation mounts
3. Restrained elastomeric isolation mounts
4. Freestanding and restrained spring isolators
5. Housed spring mounts
6. Elastomeric hangers
7. Spring hangers
8. Spring hangers with vertical-limit stops
9. Pipe riser resilient supports
10. Resilient pipe guides
11. Restraining braces and cables

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents.

1. ASTM International (ASTM)
 - a. ASTM A53 Standard Specification for Stainless Steel Rope Wire
2. American Society of Civil Engineers (ASCE)
 - a. ASCE 7 Minimum Design Loads for Buildings and Other Structures.
3. American Welding Society (AWS)
 - a. AWS D1.1/D1.1M Structural Welding Code – Steel, Second Printing, Errata
4. City of Seattle (COS)
 - a. Seattle Fire Code (International Fire Code with Seattle Amendments)
5. Manufacturers Standardization Society for the Valve and Fittings Industry (MSS)
 - a. MSS SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.03 SUBMITTALS/TRANSMITTALS

A. Submittals

1. Product Data: For each product indicated.
2. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Transmittals

1. Welding certificates
2. Qualification data for professional engineer
3. Field quality-control test reports

1.04 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- C. Seismic-restraint devices and design shall have horizontal and vertical load testing and analysis and shall bear anchorage pre approved by ICC-ES, or pre-approved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products indicated on Contract Drawings or a comparable product by one of the following:
 1. California Dynamics Corporation
 2. Kinetics Noise Control
 3. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 1. Resilient Material: Oil- and water-resistant neoprene

- C. Mounts: Double-deflection type, with molded, oil-resistant neoprene, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO
- D. Restrained Mounts: All-directional mountings with seismic restraint
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers
 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint
 2. Base: Factory drilled for bolting to structure
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar
- H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression
 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil
- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop
 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod

- 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil
- K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading
 - 1. Site Class as Defined in the IBC: C
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II
 - a. Component Importance Factor: 1.5
 - b. Component Response Modification Factor: 2.5
 - c. Component Amplification Factor: 2.5
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.85
 - 4. Design Spectral Response Acceleration at 1-Second Period: 0.43

2.03 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, provide products required for the equipment indicated on Contract Drawings or a comparable product by one of the following:
 - 1. California Dynamics Corporation
 - 2. Kinetics Noise Control
 - 3. TOLCO Incorporated; a brand of NIBCO INC.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
- C. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

- E. Restraint Cables: ASTM A492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Contract Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.02 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet on center, and longitudinal supports a maximum of 80 feet on center.
 - 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- G. Drilled-in Anchors
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Resident Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install type 304 stainless steel anchors for interior and exterior applications unless otherwise specified on Contract Drawings.

3.03 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Domestic Water Piping Section for piping flexible connections.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to Resident Engineer and the City of Seattle Code Authorities.
 - 2. Schedule test with Resident Engineer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least 7 days advance notice.
 - 3. Obtain Resident Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Resident Engineer.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.

- 7. Measure isolator deflection.
 - 8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
 - B. Remove and replace malfunctioning units and retest as specified above.
 - C. Prepare test and inspection reports.
- 3.05 ADJUSTING
- A. Adjust isolators after piping system is at operating weight.
 - B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
 - C. Adjust active height of spring isolators.
 - D. Adjust restraints to permit free movement of equipment within normal mode of operation.
- 3.06 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE
- A. As Indicated on Contract Drawings
- 3.07 COMMISSIONING
- A. Engage a factory-authorized service representative to train Sound Transit's maintenance personnel to adjust, operate, and maintain Vibration and Seismic Controls for Plumbing Piping and Equipment. See commissioning for plumbing in other sections for commissioning requirements pertaining to the work of this Section.

END OF SECTION

SECTION 22 05 50

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Requirements for the following:
 - a. Equipment labels.
 - b. Valve tags.
 - c. Warning signs and labels.
 - d. Pipe labels.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
 - 1. ANSI/ASME International:
 - a. ANSI/ASME A13.1 Scheme for Identification of Piping Systems.

1.03 SUBMITTALS

- A. Submit:
 - 1. Product Data: For each type of product indicated.
 - 2. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2 by 11-inch bond paper for mounting. Tabulate valve number, piping system, system abbreviations as shown on tag, location of valve, and variations for identification. Mark valves that are intended for emergency shut-off and similar special uses with "flags" in the margin of schedule. In addition to mounted copies, furnish copies as required for maintenance manuals.
 - 3. 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 Contract Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Contract Specifications Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
 - 4. Samples: Submit samples of each color, lettering style, and other graphic representation required for each identification material or system.

1.04 QUALITY ASSURANCE

- A. Material and Work:

1. Materials and equipment required for the work shall be new and shall be furnished, delivered, erected, installed, connected, and finished in every detail; and shall be selected and arranged to fit properly into the building spaces. Where no specific kind or quality of material is given, an article as approved by the Resident Engineer shall be provided.
 2. Equipment and materials shall be installed with the approval of the Resident Engineer in accordance with the recommendations of the manufacturer.
- B. Coordination:
1. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
 2. Coordinate installation of identifying devices with locations of access panels and doors.
 3. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 COMPONENTS

- A. Equipment Labels:
1. Description:
 - a. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 inches by 3/4 inch.
 - b. Minimum Letter Size: 1/2 inch for name of units for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. If needed, include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - c. Label Content: Include equipment's Contract Drawing designation or unique equipment number.
 2. Materials:
 - a. Material and Thickness: Multilayer, multicolor, rigid plastic polymer labels for mechanical engraving, 1/8 inch thick, or Stainless steel, 0.025 inch thick, and having predrilled holes for attachment hardware if the label shall be mounted with fasteners.
 3. Label Letter and Background Color:
 - a. Letter Color.
 4. Plastic: White.
 5. Metal: Black.
 6. Background Color:
 - a. Plastic: Black.
 - b. Metal: Natural.

7. Label Attachment Options:
 - a. Fasteners: Stainless-steel rivets or stainless-steel self-tapping screws.
 - b. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
8. Valve Tags:
 - A. Description:
 - 1) Valve Tags: 1-1/2 inches round, stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
9. Materials:
 - a. Tag Material: Brass or Stainless steel, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - b. Valve Tag Letter and Background Color:
 - 1) Letter Color: Black.
 - 2) Background Color: Natural.
10. Attachment Method:
 - a. Fasteners: Brass wire-link or beaded chain.
- B. Warning Signs and Labels for Back of House
 1. Description:
 - a. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 inches by 3/4 inch.
 - b. Minimum Letter Size: 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. If needed, include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - c. Label Content: Include caution and warning information, plus emergency notification instructions.
 2. Material:
 - a. Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware:
 - 1) Letter Color: White.
 - 2) Background Color: Red.
 3. Performance:
 - a. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
 4. Sign and Label Attachment Options:
 - a. Fasteners: Stainless-steel rivets or self-tapping screws.

- b. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Pipe Labels:

1. Description:
 - a. Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Materials:
 - a. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive. 8 inches and larger pipe, labels shall be adhered with oversized nylon straps.
 - b. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
3. Pipe Label Contents: Include identification of piping system service using same designations or abbreviations as used on contract drawings, and an arrow indication flow direction.
 - a. 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.
 - b. Lettering Size: Minimum text height per ANSI/ASME A13.1.
 - 1) Letter Color: Follow ANSI/ASME A13.1 color scheme.
 - 2) Pipe Color: Follow ANSI/ASME A13.1 color scheme.
4. Pipe Label Color Schedule:
 - a. Domestic Water Piping:
 - 1) Background Color: Green.
 - 2) Letter Color: White.
 - 3) Note type, e.g. "hot water", "cold water", "hot water recirc", etc.
 - b. Sanitary Waste and Vent Piping:
 - 1) Background Color: Brown.
 - 2) Letter Color: White.
 - c. Storm Drainage and Rain Leader Piping:
 - 1) Background Color: Black.
 - 2) Letter Color: White.
 - d. Condensate Piping:
 - 1) Background Color: Grey.
 - 2) Letter Color: White.

PART 3 - EXECUTION

3.01 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.
- B. Coordinate installation with piping insulation and heat trace installation as required.

3.02 INSTALLATION

- A. Equipment Label Installation:
 - 1. Install or permanently fasten labels on each major item of mechanical equipment.
 - 2. Locate equipment labels where accessible and visible.
- B. Valve Tag Installation:
 - 1. 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.
- C. Pipe Label Installation
 - 1. Locate pipe label 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:
 - a. Near each valve and control device.
 - b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - g. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION

SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for the following soil and waste, sanitary drainage, and vent piping inside the building:
 - a. Pipe, tube, and fittings.
 - b. Special pipe fittings.

1.02 REFERENCES

A. This section incorporates by reference the latest revisions of the following documents:

1. ASTM International (ASTM):
 - a. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. ASTM A74 Standard Specification for Cast Iron Soil Pipe and Fittings.
 - c. ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - d. ASTM A733 Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
 - e. ASTM A888 Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - f. ASTM B32 Standard Specification for Solder Metal.
 - g. ASTM B306 Standard Specification for Copper Drainage Tube (DWV).
 - h. ASTM B813 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
 - i. ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - j. ASTM C564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - k. ASTM C1277 Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

2. American Society of Sanitary Engineering (ASSE):
 - a. ASSE 1043 Performance Requirements for Cast Iron Sanitary Drainage Systems.
3. Manufacturers Standardization Society (MSS):
 - a. MSS SP-69 Pipe Hangers and Supports – Selection and Applications.

1.03 SUBMITTALS

- A. Submit:
 1. Shop Drawings.
 2. Inspection Reports.
 3. Field quality-control inspection and test reports.

1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of an independent testing laboratory.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A74, Service class:
 1. Gaskets: ASTM C564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A888 or CISPI 301:
 1. Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 2. Shielded Couplings: ASTM C1277 or CISPI 301 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop:
 - a. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C564, rubber sleeve.
- C. Steel Pipe: ASTM A53/A53M, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method:
 1. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
 2. Pressure Fittings:
 - a. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or.
 - b. ASTM A106, Schedule 40, galvanized, seamless steel pipe; include ends matching joining method.

- c. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - d. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 - e. Cast-Iron Flanges: ASME B16.1, Class 125.
 - f. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
- D. Copper DWV Tube: ASTM B306, drainage tube, drawn temper:
- 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping shall be any of the following: Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless- coupling joints:
 - 1. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - a. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - b. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
- D. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

3.02 INSTALLATION

- A. Piping Installation:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
 - 2. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals, and wall sleeves shall apply. 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."

3. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. 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. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 4. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 5. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - a. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 4 and smaller; for pipe larger than NPS 4 1 percent downward in direction of flow for piping is allowed.
 - b. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - c. Vent piping: 2 percent down toward vertical fixture vent or toward vent stack unless indicated otherwise.
 6. Sleeves are not required for cast iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
 7. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- B. Joint Construction:
1. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 2. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 3. Hubless Joints: Make with rubber gasket and sleeve or clamp.
 4. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free alloy solder; and ASTM B828 procedure, unless otherwise indicated.
- C. Valve Installation:
1. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - a. Use gate or full-port ball valve for piping NPS 2 and smaller.
 - b. Use gate valve for piping NPS 2-1/2 and larger.
 2. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
 3. Backwater Valves: Install backwater valves in piping subject to sewage backflow:

- a. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - b. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - c. Install backwater valves in accessible locations.
- D. Hanger and Support Installation:
 - 1. Pipe Hangers:
 - a. Vertical Piping MSS Type 8 or Type 42, clamps.
 - b. Individual, Straight, Horizontal Piping Runs: According to the following:
 - 1) 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2) Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3) Longer than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
 - 2. Install supports as required.
 - 3. Support vertical piping and tubing at base and at each floor.
 - 4. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
 - 5. Install hangers for cast-iron soil piping, steel piping and copper tubing with the following maximum horizontal spacing and minimum rod diameters as specified in UPC:
 - a. Install supports for vertical cast-iron soil piping, steel piping and copper piping as specified in UPC.
 - 6. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions and meet the requirements of UPC.
- E. Connections:
 - 1. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
 - 2. Connect drainage and vent piping to the following:
 - a. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - b. Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - c. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code and specification section of Sanitary Waste Piping Specialties.
 - d. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.03 FIELD QUALITY CONTROL

- A. During installation, notify Resident Engineer at least 24 hours before inspection shall be performed. Perform tests specified below in presence of Resident Engineer and the Authority having Jurisdiction (AHJ):
 - 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 Resident Engineer and the AHJ to observe tests specified below and to ensure compliance with requirements.
 - 3. Installation Verification shall apply prior to and before commissioning. Refer to commissioning of plumbing in other sections for verification documentation.
- B. Reinspection: If Resident Engineer and the AHJ 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 Resident Engineer and the AHJ.
- D. Test sanitary drainage and vent piping according to manufacturers' procedures of Resident Engineer and the AHJ:
 - 1. Test installed drainage lines and equipment according to Section 22 08 00 - Commissioning of Plumbing. Provide and dispose of water required for testing.
 - 2. Prepare reports for tests and required corrective action.
- E. 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.

3.04 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains 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.

3.05 TRAINING

- A. Engage a factory-authorized service representative to train Sound Transit's maintenance personnel to adjust, operate, and maintain Sanitary Waste and Vent Piping systems and equipment See Section 22 08 00 - Commissioning of Plumbing for commissioning requirements pertaining to the work of this section.
- B. Engage a factory-authorized service representative to train Sound Transit's maintenance personnel to adjust, operate, and maintain Sanitary Waste and Vent Piping systems and equipment. See commissioning of plumbing in other sections for commissioning requirements pertaining to the work of this Section.

END OF SECTION

SECTION 22 08 00
COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for Commissioning process for Plumbing, including:
 - a. Level 1 commissioning activities for plumbing.
 - b. Level 2 commissioning activities for plumbing.
 - c. Support for Level 3 commissioning activities related to plumbing.
 - d. Support for Level 4 commissioning activities related to plumbing.
- B. Refer to the general commissioning requirements as stated elsewhere in the Contract Documents for general commissioning process requirements, including definitions, submittals, scheduling, execution of commissioning activities, and reporting.

1.02 REFERENCES

- A. Definitions:
 - 1. See general commissioning requirements as stated elsewhere in the Contract Documents for commissioning definitions.
 - 2. Command: When used in the description of a commissioning activity, command means to use the station human machine interface (HMI) for the building management system (BMS) to control systems, equipment and components.
 - 3. Human Machine Interface (HMI): Equipment, software, and functional programming at the locations shown on the Plans and according to field control system (FCS) as stated elsewhere in the Contract Documents.
 - 4. Systems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, equipment, and components.

1.03 COORDINATION

- A. See general commissioning requirements as stated elsewhere in the Contract Documents for general coordination requirements related to commissioning.

1.04 COMMISSIONING ACTIVITIES

- A. Furnish labor and material to accomplish building commissioning as referred in the general commissioning requirements as stated elsewhere in the Contract Documents, and herein, including:
 - 1. Provide to the Sound Transit Testing and Commissioning Manager preliminary O&M information for use in developing commissioning test procedures.

2. Assist the Sound Transit Testing and Commissioning Manager in developing commissioning activity procedures and data forms submittals for work specified in this Section.
 3. Provide information to the Testing and Commissioning Manager needed for control interface wiring diagrams submittals for the work of this Section.
 4. Perform Level 1 and Level 2 commissioning activities specified in this Section, including installation verification, static tests, start-up, component tests, equipment tests, systems tests, and intrastation system interface tests.
 5. Provide support for Level 3 commissioning activities, including jointly with the communications system contractor field testing points in the interface terminal strips, being present during level 3 testing with adequate labor and support personnel to adjust equipment and troubleshoot system failures that might arise. When material or equipment provided by this Division is found to be in conflict with specified criteria, adjust or replace said material or equipment, with the assistance of manufacturer as needed.
 6. Operate equipment and system during commissioning activities as required by the Testing and Commissioning Manager.
 7. Perform and document commissioning tests to verify readiness for commissioning test demonstration. Commissioning tests are specified herein.
 8. Correct issues and repeat commissioning tests when results do not meet acceptance criteria.
 9. Commissioning Test Demonstrations: Comply with general commissioning requirements, Level 1 and Level 2 commissioning activity commissioning test demonstrations as stated elsewhere in the Contract Documents:
 - a. Repeat commissioning tests on a sample basis to demonstrate acceptable performance: Level 1 Component, Equipment, and System Commissioning Tests, and for Level 2 Intra-station system interface tests.
 - b. Record and submit commissioning test demonstration data and issues.
 - c. Correct issues and repeat commissioning test demonstration when results do not meet Acceptance Criteria.
 10. Attend commissioning meetings as requested by the Sound Transit Testing and Commissioning Manager.
 11. Report any inconsistencies or issues in system operations or performance.
 12. Provide personnel to support commissioning test demonstration specified herein as requested by the Sound Transit Commissioning Coordinator.
 13. In the event that a commissioning test demonstration fails, assist in determining the cause of failure. Make corrections as necessary.
- B. Cooperate with Sound Transit Testing and Commissioning Manager to make equipment and systems ready for commissioning tests specified herein as early in the construction schedule as possible.

1.05 QUALITY ASSURANCE

- A. Coordinate completion of Install Verification forms, by the Quality Control Inspector, as identified in the Contractors Quality Control Inspection and Test Plan.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide test equipment and instrumentation, including consumable supplies, required to execute commissioning activities. Unless noted otherwise, test equipment and instrumentation remain the property of the Contractor.
- B. Provide proprietary test instruments or tools required by the equipment manufacturer. Provide and operate the proprietary test instruments or tools as required for commissioning work.

PART 3 - EXECUTION

3.01 LEVEL 1 COMMISSIONING ACTIVITIES REQUIREMENTS

- A. Level 1 commissioning activities scope: Technical requirements for commissioning of plumbing are specified herein.
- B. Provide technicians, instrumentation, and tools to perform commissioning activities in accordance with accepted commissioning activity procedures at the direction of the Sound Transit Testing and Commissioning Manager.
- C. Scope of plumbing commissioning activities applies to all portions of the plumbing installation described in the test. Where sampling is specified, it applies only to the commissioning test demonstration.
- D. Upon approval of product submittals associated with the Technical requirements and the scope of Commissioning develop and submit for approval Install Verification Checklist forms for the quality criteria of the Work specified herein.
- E. Preparation:
 - 1. Certify that plumbing systems, equipment, and materials have been completed, calibrated, and started; and are operating in accordance with Contract Documents.
 - 2. Testing Instrumentation: Install measuring instruments and logging devices to record test data in accordance with accepted commissioning test procedures as directed by the Testing and Commissioning Manager.
 - 3. Certify that plumbing instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.
- F. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- G. Perform tests using design conditions whenever possible. If tests cannot be completed because of a deficiency outside the scope of the Equipment system, document the deficiency and report it to Sound Transit. After deficiencies are resolved, reschedule tests.
- H. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Provide equipment to simulate loads. Set simulated conditions in accordance with accepted commissioning test procedures as directed by the Testing and Commissioning Manager. Document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

- I. Request approval to alter set points when simulating conditions is not practical. Request approval to alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical.
- J. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Sound Transit. After deficiencies are resolved, reschedule tests.
- K. Where seasonal testing is specified, complete appropriate initial commissioning tests and documentation within the Construction Period. Schedule and execute seasonal tests when specified conditions are expected.

3.02 LEVEL 1 AND LEVEL 2 COMMISSIONING ACTIVITY PROCEDURES

- A. Submit Level 1 commissioning activity test procedures and data forms for the following types of commissioning activities, requirements for which are specified herein:
 - 1. Level 1 commissioning activities:
 - a. Installation verification.
 - b. Static tests.
 - c. Start-up procedures.
 - d. Component tests.
 - e. Equipment tests.
 - f. System tests.
 - 2. Level 2 commissioning activities:
 - a. Intra-station system interface tests.

3.03 LEVEL 1 INSTALLATION VERIFICATION CHECKLIST REQUIREMENTS

- A. Installation verification checklist forms shall include the following:
 - 1. Organized to prompt the installer to check off quality criteria for each discrete portion of the Work.
 - 2. Identify the system or features to which the installation verification checklist applies at the top of the form.
 - 3. Section for verification of delivery of accepted materials.
 - 4. Section for condition of materials at delivery.
 - 5. Section for verification that installation meets contract documentation and any special installation instructions by respective manufacture.
 - 6. Space at the end of the form for the installer to print their name, fill in the date, and sign or initial.
 - 7. Space at the end of the form for the Quality Control inspector designated for the scope to review and accept installation verification. QC Inspector must perform Install Verification and verify each element identified in form has been reviewed for conformance with contract documents and in accordance with the Contractors Quality Control Inspection and Test Plan as part of Section 01 45 00 – Quality Assurance / Quality Control.

8. Space to identify the area of work for which the installer is executing the Installation Verification Checklist.
 9. Description of the quality criteria as it pertains to the specific work. Include a check-box for each criterion.
 10. Example checklists/test forms can be provided upon request.
- B. Quality Criteria: Installation verification checklists shall address the following quality criteria:
1. Make and model match accepted submittals, including for motors, full load amperage rating and winding insulation class.
 2. Equipment is installed without visible damage.
 3. Location is as indicated on drawings.
 4. Equipment is accessible for maintenance using safe work practices.
 5. There is sufficient space to remove and replace components intact without demolishing other work.
 6. Equipment surfaces are clean and free of dust, dirt, oil and other contaminants.
 7. Equipment is accessible for adjustment, maintenance, and testing, including replacement of components or the entire assembly.
 8. Piping is properly supported and seismically braced.
 9. Equipment is installed level, or pitched per manufacturer's requirements.
 10. Waste and vent piping is installed with required pitch without reverse pitch.
 11. Vibration isolation devices are adjusted to required static deflection and support the equipment level.
 12. Before performing a commissioning test, installation verification checklists must be performed and completed by QC inspector designated for the appropriate area specified here in and within the Contractors Quality Control Inspection and Test Plan as part of Section 01 45 00 – Quality Assurance / Quality Control. Submit completed installation verification checklists for work included in the commissioning test. Erection / Installation / Application
- C. Fill out and sign installation verification checklists for plumbing while the Work is being installed. The intent is to fill out and sign the installation verification checklist as work proceeds to improve the quality of the installation. Retain completed installation verification checklists on site for review.

3.04 LEVEL 1 INSTALLATION VERIFICATION

- A. Installation Verification checklists are required to include the following, at a minimum:
1. 2208-IV-01 Meters and Gages for Plumbing Piping:
 - a. Metal-case, liquid-in-glass thermometers.
 - b. Bimetallic-actuated dial thermometers.
 - c. Pressure gages.

2. 2208-IV-02 General-duty valves for plumbing piping.
3. 2208-IV-03 Domestic Water Piping:
 - a. Domestic water piping.
4. 2208-IV-04 Domestic Water Piping Specialties:
 - a. Reduced pressure backflow preventers.
 - b. Double check valves.
 - c. Water pressure reducing valves – water regulators.
 - d. Trap-seal primer valves.
 - e. Balancing Valves.
 - f. Vibration and seismic controls for plumbing piping and equipment.
5. 2208-IV-05 Sanitary Waste and Vent Piping:
 - a. Sanitary and vent piping.
 - b. Oil/water separator.
 - c. Vibration and seismic controls for plumbing piping and equipment.
6. 2208-IV-06 Pumping Station Piping and Appurtenances:
 - a. Drainage pumping station piping and appurtenances.
7. 2208-IV-07 Facility Storm Drainage and Drainage System for Structure Piping:
 - a. Storm drainage piping.
 - b. Vibration and seismic controls for plumbing piping and equipment.
8. 2208-IV-08 Sump Pumps:
 - a. Pumps and pump controls for the wastewater pump station.
9. 2208-IV-09 Electric Domestic Water Heaters:
 - a. Electric domestic water heater and controls.
10. 2208-IV-10 Heat Tracing for Plumbing, including:
 - a. Heating cable installation, securement, termination.
 - b. Heater trace circuit controller.
 - c. Remote temperature sensor.
11. 2208-IV-10 Plumbing Fixtures:
 - a. Lavatories.
 - b. Mop Sinks.
 - c. Service sinks.
 - d. Urinals.

- e. Water closets.
- f. Drinking Fountains.
- g. Hose Bibbs.

3.05 LEVEL 1 STATIC TESTS

A. Static Test checklists are required to include the following, at a minimum:

1. 2208-ST-01: Water Piping Leak Test:
 - a. System/Equipment to be Tested:
 - 1) Domestic water piping: Refer to the domestic water piping as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) See "Test domestic water piping" as stated elsewhere in the Contract Documents.
 - c. Conditions of the Test:
 - 1) See "Test domestic water piping" as stated elsewhere in the Contract Documents.
 - d. Acceptable Results:
 - 1) See "Test domestic water piping" as stated elsewhere in the Contract Documents.
2. 2208-ST-02: Sanitary Waste and Vent Pipe Leak Test:
 - a. System/Equipment to be Tested:
 - 1) For waste and vent piping refer to the sanitary waste and vent piping as stated elsewhere in the Contract Documents, including Sanitary Waste Sump and associated access door.
 - b. Functions to be Tested:
 - 1) Leakage under gravity pressure.
 - c. Conditions of the Test:
 - 1) Test shall be successfully completed before covering piping.
 - 2) Plug openings and fill system with water such that all pipe joints and fittings are subjected to 10 feet of water head pressure. Exception: piping that penetrates the roof shall be filled to fullest height.
 - 3) One hour after the system or section has been filled; visually inspect the piping for evidence of leakage.
 - 4) Include in Static Test Procedures and Data Forms submittal:
 - a) Leakage testing plan showing how piping will be divided if testing will be performed in sections.
 - d. Acceptable Results:
 - 1) No visible evidence of leakage.

3. 2208-ST-03: Storm Drainage Pipe Leak Test
 - a. System/Equipment to be Tested:
 - 1) Storm drainage piping: Comply with facility storm drainage piping as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Leakage under gravity pressure.
 - c. Conditions of the Test:
 - 1) Test shall be successfully completed before covering piping.
 - 2) Plug openings and fill system with water such that all pipe joints and fittings are subjected to 10 feet of water head pressure. Exception: piping that penetrates the roof shall be filled to fullest height.
 - 3) One hour after the system of section has been filled: visually inspect the piping for evidence of leakage.
 - 4) Include in Static Test Procedures and Data Forms submittal:
 - a) Leakage testing plan showing how piping will be divided if testing will be performed in sections.
 - d. Acceptable Results:
 - 1) No visible evidence of leakage.

3.06 LEVEL 1 START-UP

A. Start-up checklists are required to include the following, at a minimum:

1. 2208-SU-01: Domestic Water Heater Start-up:
 - a. System/Equipment to be Tested:
 - 1) Domestic water heater and associated controls.
 - b. Functions to be Tested:
 - 1) For installation of water heater refer to the electric domestic water heaters as stated elsewhere in the Contract Documents.
 - 2) Installation and start-up per manufacturer's recommendations.
 - c. Conditions of the Test:
 - 1) Perform start-up according to manufacturer's procedures. Start-up by manufacturer-authorized personnel. Use manufacturer's data forms to record start-up results.
 - d. Acceptable Results:
 - 1) Installation and start-up meet the manufacturer's requirements.
2. 2208-SU-02: Submersible Sewage Pumps:
 - a. System/Equipment to be Tested:
 - 1) Submersible Sewage Pumps and associated pump controls.
 - b. Functions to be Tested:

- 1) For installation refer to the sump pumps as stated elsewhere in the Contract Documents.
 - 2) Installation and start-up per manufacturer's recommendations.
 - c. Conditions of the Test:
 - 1) Perform start-up according to manufacturer's procedures. Start-up by manufacturer-authorized personnel. Use manufacturer's data forms to record start-up results.
 - d. Acceptable Results:
 - 1) Installation and start-up meet the manufacturer's requirements.
- 3. 2208-SU-03: Trap Seal Primers:
 - a. System/Equipment to be Tested:
 - 1) All Trap Seal Primers and associated controls.
 - b. Functions to be Tested:
 - 1) Installation per trap seal primers as stated elsewhere in the Contract Documents.
 - 2) Installation and start-up per manufacturer's recommendations.
 - c. Conditions of the Test:
 - 1) Perform start-up according to manufacturer's procedures. Start-up by manufacturer-authorized personnel. Use manufacturer's data forms to record start-up results.
 - d. Acceptable Results:
 - 1) Installation and start-up meet the manufacturer's requirements.

3.07 LEVEL 1 COMPONENT TESTS

A. Component Test checklists are required to include the following, at a minimum:

- 1. 2208-C-01: Water Pressure Gauge Calibration:
 - a. System/Equipment to be Tested:
 - 1) For fluid pressure gauges in plumbing systems refer to the meters and gages for plumbing piping requirements as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Accuracy of fluid pressure indication.
 - c. Conditions of the Test:
 - 1) Systems in which pressure gauges are installed shall operate at their normal flow rates and pressures during the test.
 - a) Subject pressure gauge to pressure at or near the high pressure at which the system is scheduled to operate. Subject calibration instrument to the same pressure. Record pressures indicated by both instruments.

- b) Subject pressure gauge to pressure at or near the low pressure at which the system is scheduled to operate. Subject calibration instrument to the same pressure. Record pressures indicated by both instruments.
 - c) With system pressure stable, install calibration instrument in place of the pressure gauge. Record calibration instrument pressure. Install the pressure gauge in the same location. Record pressure gauge pressure.
 - d. Acceptable Results:
 - 1) Pressure gauge pressures recorded at each stage shall be within plus or minus 2.0 percent of calibration instrument pressures.
- 2. 2208-C-02: Trap Primers:
 - a. System/Equipment to be Tested:
 - 1) For trap seal primer valve stations and controls refer to the domestic water piping specialties requirements as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Priming of floor drain traps.
 - 2) Control timer operation.
 - c. Conditions of the Test:
 - 1) Operate each trap primer station by activating the override. Observe and record results at each primed drain.
 - 2) Observe operation of each trap primer station timer.
 - d. Acceptable Results:
 - 1) Each primed floor drain trap receives water from the trap primer when the override is actuated.
 - 2) Trap primer valve opens for 10 seconds once in 24 hours.
- 3. 2208-C-03: Backflow Preventers:
 - a. System/Equipment to be Tested:
 - 1) For reduced-pressure-principle backflow preventers in plumbing systems refer to the domestic water piping specialties requirements as stated elsewhere in the Contract Documents.
 - 2) For double-check backflow prevention assemblies in plumbing systems refer to the domestic water piping specialties requirements as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Backflow assembly functions mandated by the authority having jurisdiction (AHJ).
 - c. Conditions of the Test:

- 1) Perform field test of backflow preventers in accordance with requirements of the local AHJ.
 - d. Acceptable Results:
 - 1) Backflow preventer functions as required by AHJ.
 4. 2208-C-04: Actuated Drain Valves:
 - a. System/Equipment to be Tested:
 - 1) For all pumping station actuated drain valves refer to the pumping station piping and appurtenances as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Opening and closing of valves.
 - c. Conditions of the Test:
 - 1) Command valve closed. Fill force main with water.
 - 2) Command valve open for 10 seconds.
 - 3) Command valve closed.
 - d. Acceptable Results:
 - 1) Valve closes and does not leak when force main is filled.
 - 2) Valve opens and water drains freely.
 - 3) Valve closes and does not leak.
 5. 2208-C-05: Water Pressure-Reducing Valves:
 - a. System/Equipment to be Tested:
 - 1) For water regulators in plumbing systems refer to the domestic water piping specialties requirements as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Control of outlet pressure under varying flows.
 - c. Conditions of the Test: During the test, ensure that only test personnel operate water valves in the system.
 - 1) With all valves closed, observe water pressure downstream of regulators.
 - 2) Open one lavatory valve. Observe water pressure downstream of regulators for one minute.
 - 3) Open sufficient valves to increase flow to approximately 10 percent of design flow. Observe water pressure downstream of regulators for one minute.
 - 4) Open sufficient valves to increase flow to approximately 50 percent of design flow. Observe water pressure downstream of regulators for one minute.

- 5) Continue opening valves to increase flow to approximately 100 percent of design flow. Observe water pressure downstream of regulators for one (1) minute.
 - d. Acceptable Results:
 - 1) For all conditions, downstream pressure is stable within plus or minus 2 pounds per square inch of setpoint (60 pounds per square inch initially).
6. 2208-C-06: Oil Separators:
- a. System/Equipment to be Tested:
 - 1) Oil Separators in plumbing systems; refer to sanitary waste and vent piping requirements as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Ability to capture and prevent the migration of oil past the interceptor.
 - c. Conditions of the Test: During the test, ensure that only test personnel operate the components of the interceptor.
 - 1) Verify that the interceptor is provided with all baffles and components required for correct operation.
 - 2) Verify that the interceptor is level to within the manufacturer's tolerances for proper operation.
 - 3) Introduce a small amount of oil into the inlet side of the interceptor while waste water is actively flowing through it.
 - d. Acceptable Results:
 - 1) With water flowing through the unit, oil remains trapped in the containment chamber without passing through to the exit side of the unit.

3.08 LEVEL 1 EQUIPMENT TESTS

A. Equipment Test checklists are required to include the following, at a minimum:

- 1. 2208-E-01: Sump Pump Controller:
 - a. System/Equipment to be Tested:
 - 1) For sanitary sewage pumps and associated pump controls for sanitary sewage pump stations refer to the sump pumps as stated elsewhere in the Contract Documents.
 - b. Functions to be Tested:
 - 1) Pump controller digital point LED display.
 - 2) Pump controller analog point display.
 - 3) Pump controller operator interface display.
 - c. Conditions of the Test:

- 1) Switch the status of each digital point and observe the corresponding LED display.
 - 2) Vary the input or output value of each analog point and observe the corresponding display.
 - 3) Demonstrate dynamic display of process parameters, process equipment and all associated controlled and monitored process variables being monitored by the PLC processor.
 - 4) Modify a randomly selected sample of ten process parameters being monitored by the PLC processor. Restore original values at the completion of the step.
- d. Acceptable Results:
- 1) LED display is present and correctly reflects status of digital points.
 - 2) Display is present and correctly reflects value of analog points.
 - 3) Process parameters, process equipment and all associated controlled and monitored process variables display correct dynamic values.
 - 4) Selected parameters are capable of being changed and saved to memory.
2. 2208-E-02: Sump Pump Operation:
- a. System/Equipment to be Tested:
- 1) All sanitary sewage pumps and associated pump controls for sanitary sewage pump stations, refer to sump pumps requirements as stated elsewhere in the Contract Documents.
- b. Functions to be Tested:
- 1) Sump pump control and alarm functions.
- c. Conditions of the Test:
- 1) Determine water volume in sump between high level alarm signal level and low level cutoff level.
 - 2) With all pumps disabled, verify rising water levels at which each pump is commanded to start, and the level at which the high level alarm signal is initiated at the pump control panel.
 - 3) With one pump enabled, verify falling water levels at which the high level alarm signal is cancelled and the level at which each pump is commanded to stop.
 - 4) Fill to normal "pump on" elevation with all pumps enabled.
 - 5) Repeat and fill to normal "pump on" elevation with all pumps enabled.
 - 6) Fill to high water level while both pumps are disabled and then re-enable the pumps to operate.
 - 7) Turn the electrical disconnect off to one of the pumps.

- 8) Loss of building normal electrical power.
- d. Acceptable Results:
 - 1) Switch and alarm action occurs within plus or minus 1.0 inch of scheduled level.
 - 2) Switch and alarm action occurs within plus or minus 1.0 inch of scheduled level.
 - 3) The pump controller automatically changes the designation of the lead and lag pumps (automatic alternation of lead pump) and the newly-designated lead pump turns on and then automatically shuts off at the "pump off" elevation.
 - 4) With water at high water level, and pumps re-enabled, both pumps start and then stop when the water level reaches the "pump off" elevation.
 - 5) The pump that still has electrical service to its controller operates continues to operate correctly when the other pump has lost electrical service.
 - 6) The sump pumps continue to operate under emergency power with no operator intervention or nuisance alarms when pumps switch between normal to emergency power and then back again from emergency to normal power.

3. 2208-E-03: Sump Pump Removal and Reinstallation:

- a. System/Equipment to be Tested:
 - 1) For sanitary sewage pumps and associated pump controls for sanitary sewage pump stations refer to the sump pumps as stated elsewhere in the Contract Documents.
- b. Functions to be Tested:
 - 1) Ability to remove sump pump from sump without entering sump.
 - 2) Ability to reinstall sump pump in sump without entering sump.
- c. Conditions of the Test: Prerequisite:
 - 1) Following manufacturer's instructions, remove sump pump from sump without entering sump.
 - 2) Following manufacturer's instructions, reinstall sump pump in sump without entering sump.
 - 3) Restore automatic control equipment and functions to normal operating condition. Fill the sump with water until the pump starts automatically. Measure the pump-down time.
- d. Acceptable Results:
 - 1) Pump removal, using manufacturer's recommended tools and methods, proceeds without incident.
 - 2) Pump reinstallation, using manufacturer's recommended tools and methods, proceeds without incident.

- 3) Pump starts and stops automatically. Pump runs normally. Pump-down time is the same as noted during Level 1 test 2208-E-02, Sump Pump Operation
4. 2208-E-04: Heat Tracing Control for Plumbing:
 - a. System/equipment to be tested:
 - 1) Self-Regulating, Parallel-Resistance Heating Cables.
 - 2) Heater Trace Circuit Controller.
 - b. Functions to be tested:
 - 1) Response to ambient temperature below freeze protection setpoint.
 - 2) Heating cable fault alarm.
 - c. Conditions of the test:
 - 1) Subject temperature sensor to temperature approximately 3 degrees Fahrenheit above freeze protection setpoint (initial setpoint 41 degrees Fahrenheit). Monitor sensed temperature with a calibration-grade thermometer. Gradually change setpoint or sensed temperature until freeze protection circuit is energized.
 - 2) Simulate an electrical fault on the heating cable.
 - d. Acceptance Criteria:
 - 1) Freeze protection circuit is energized at setpoint temperature minus 2 degrees Fahrenheit.
 - 2) Heater trace circuit controller initiates an alarm of cable fault. Alarm is correctly reported at BMS panel.
5. 2208-E-05: Trap Seal Primers:
 - a. System/Equipment to be Tested:
 - 1) All Trap Seal Primers and associated controls.
 - b. Functions to be Tested:
 - 1) Installation per trap seal primers as stated elsewhere in the Contract Documents.
 - 2) Installation and start-up per manufacturer's recommendations.
 - c. Conditions of the Test:
 - 1) Perform start-up according to manufacturer's procedures. Start-up by manufacturer-authorized personnel. Use manufacturer's data forms to record start-up results.
 - d. Acceptable Results:
 - 1) Installation and start-up meet the manufacturer's requirements.
6. 2208-E-06: Domestic Water Heaters:

- a. System/Equipment to be Tested:
 - 1) Domestic water heater and associated controls.
- b. Functions to be Tested:
 - 1) For installation of water heater refer to the electric domestic water heaters as stated elsewhere in the Contract Documents.
 - 2) Installation and start-up per manufacturer's recommendations.
- c. Conditions of the Test:
 - 1) Perform start-up according to manufacturer's procedures. Start-up by manufacturer-authorized personnel. Use manufacturer's data forms to record start-up results.
- d. Acceptable Results:
 - 1) Installation and start-up meet the manufacturer's requirements.

3.09 LEVEL 1 SYSTEM TESTS

A. System Test checklists are required to include the following, at a minimum:

- 1. 2208-S-01: Sanitary Sewage Pumps: System:
 - a. System/Equipment to be Tested:
 - 1) All Track Drainage Pumps and associated pump controls for the sanitary sewage pump station and sump pumps.
 - b. Functions to be Tested:
 - 1) Sequence of operation.
 - c. Conditions of the Test: Start the test with all controls in normal, automatic control, and all pumps enabled. Pumps may be temporarily disabled while filling the sump to the required level.
 - 1) Sump fluid level below the "Low Level Alarm" level. Lead pump: "Off".
 - 2) Sump fluid level above the "Low Level Alarm" level and below the first pump "On" level.
 - 3) Disconnect communication link with BMS. Sump fluid level above the first pump "On" level and below the second pump "On" level.
 - 4) Sump fluid level above the second pump "On" level and below the "High Water Alarm" level.
 - 5) Restore communication link with BMS. Sump fluid level above the "High Water Alarm" level.
 - 6) Verify response to failure of a pump by failing each pump in turn while it is operating as the lead pump. Restore each pump to normal control after verifying response to failure and before failing the next pump.

- d. Acceptable Results:
- 1) "Low Level Alarm" is activated and communicated to the BMS. All pumps are "Off."
 - 2) "Low Level Alarm" is cleared and communicated to the BMS. All pumps are "Off."
 - 3) Loss of communication with BMS does not impair local control. Lead pump is "On," and "Stops" after water level falls below the "All Pumps Off" level. The lead pump is "Off".
 - 4) Lead pump, and lag pump are "On," and "Stop" after water level falls below the "All Pumps Off" level. The lead pump is "Off".
 - 5) Restoration of communication link with BMS does not impair control. The "High Water Alarm" is activated and communicated to the BMS. Lead pump and lag pump are "On," and "Stop" after water level falls below the "All Pumps Off" level. The "High Water Alarm" is cleared and communicated to the BMS after water level falls below "High Water Alarm" level. The lead pump is "Off".
 - 6) When a pump fails, the next pump in the operating sequence shall start and a common alarm shall be annunciated at the Operations Control Center.

2. 2208-S-02: Sanitary Sewage Pump – System:

- a. System/Equipment to be Tested:
- 1) For track drainage pumps, and associated pump controls for the sanitary sewage pump station, refer to the sump pumps as stated elsewhere in the Contract Documents.
- b. Functions to be Tested:
- 1) Sequence of operation.
- c. Conditions of the Test: Start the test with all controls in normal, automatic control, and pump enabled. Pump may be temporarily disabled while filling the sump to the required level.
- 1) Sump fluid level below the "Low Level Alarm" level.
 - 2) Sump fluid level above the "Low Level Alarm" level and below pump "On" level.
 - 3) Disconnect communication link with BMS. Sump fluid level above pump "On" level and below the "High Water Alarm" level.
 - 4) Restore communication link with BMS. Sump fluid level above the "High Water Alarm" level.
 - 5) Verify response to failure of pump by failing pump while it is operating. Restore pump to normal control after verifying response to failure.
- d. Acceptable Results:
- 1) "Low Level Alarm" is activated and communicated to the BMS. Pump is "Off."

- 2) "Low Level Alarm" is cleared and communicated to the BMS. Pump is "Off."
- 3) Loss of communication with BMS does not impair local control. Pump is "On," and "Stops" after water level falls below the "Pump Off" level.
- 4) Restoration of communication link with BMS does not impair control. The "High Water Alarm" is activated and communicated to the BMS. Pump is "On," and "Stops" after water level falls below the "Pump Off" level. The "High Water Alarm" is cleared and communicated to the BMS after water level falls below "High Water Alarm" level.
- 5) When pump fails, a common alarm shall be annunciated at the Operations Control Center.

3.10 LEVEL 1 AND LEVEL 2 TEST REQUIREMENTS MATRIX

	2208-IV-0X	2208-ST-0X	2208-SU-0X	2208-C-0X	2208-E-0X	2208-S-0X
Meter and Gauges for plumbing piping	X					
General-duty valves for plumbing piping	X					
Domestic Water Piping	X					
Domestic water specialties	X					
	X					
Vibration and seismic controls for plumbing piping and equipment	X					
Sanitary waste and vent piping	X					
Sanitary waste and vent piping specialties	X					
Pumping station piping and appurtenances	X					
Drainage system for structures	X					
	X					
Facility storm drainage piping	X					
Storm drainage piping specialties	X					
Sump pumps	X					
Electric domestic water heaters	X					
Heat tracing for plumbing piping	X					
Plumbing fixtures	X					
Water piping leak test		X				
Sanitary Waste and Vent Pipe Leak Test		X				
Storm Drainage Pipe Leak Test		X				
Domestic water heater start-up			X			
Submersible Sewage Pumps			X			
Trap Seal Primers			X			
Water Pressure Gauge Calibration				X		
Trap Primers				X		
Backflow Preventers				X		
Actuated Drain Valves				X		
Water Pressure Reducing Valves				X		
Oil Separators				X		
Sump Pump Controller					X	
Sump Pump Operation					X	
Sump Pump Removal and Reinstallation					X	

	2208-IV-0X	2208-ST-0X	2208-SU-0X	2208-C-0X	2208-E-0X	2208-S-0X
Heat Tracing Control for Plumbing					X	
Trap Seal Primers					X	
Domestic Water Heaters					X	
Sanitary Sewage Pumps: System						X
Sanitary Sewage Pump: System						X

END OF SECTION

EXHIBITS – (On Proceeding Pages)

1. EXHIBIT A – Sample Test Forms

EXHIBIT A:**SAMPLE TEST FORMS**

Test No. xxx-2208-IV-xx.xx

Project Name: xxxxxx xxxxx

Sump Pumps

Test Rev 1.0 – 12/01/2023

Specification Section 22 14 29

☐ First Test☐ PASS

Test Date: _____

☐ Repeat Test☐ FAIL**OBJECTIVES:**

- A. Verify that the domestic booster pump is installed to code, manufacturer's instructions, and design document requirements.

EQUIPMENT TO BE TESTED:

Equipment ID	Description
SP-1	
SP-2/SP-3	

REFERENCE DOCUMENTS:

Document
Drawings:
Specification Sections:
Submittals:

TEST PRE-REQUISITES:

Activity	Notes	Completed?	
		Yes	No
None		☐	☐
Notes: (1)			

MINIMUM PARTICIPANTS:

Participant	Notes	Required?	
		Yes	No
Installing contractor		☒	☐
Sound Transit site quality inspector		☐	☐

Notes:

(1)

REQUIRED INSTRUMENTATION AND EQUIPMENT:

Instrument or Equipment						Notes	Provided Instrumentation meets Requirements?	
Type or Sensed Parameter	Manufacturer	Model	Range	Accuracy	Calibration Date/ Next Cal. Due		Yes	No
None				±	/		☐	☐
							☐	☐
Notes:								
(1)								

CONDITIONS AT TIME OF TESTING:

--

AREA OF WORK:

Area in Which Work will be Conducted:
Notes:
(1)

ISSUES DISCOVERED AND PROPOSED RESOLUTIONS:

No.	Issue	Proposed Resolution

Notes:

(1)

SIGNATURES:

Company	Printed Name	Signature	Date
Installing Contractor:			
Quality Control:			
Other Witness:			

END OF EXHIBITS

SECTION 22 14 23
STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes specifications for the following storm drainage piping specialties:
 - 1. Backwater valves
 - 2. Cleanouts
 - 3. Roof drains
 - 4. Area drains
 - 5. Trench drains
 - 6. Miscellaneous storm drainage piping specialties

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents.
 - 1. American Society of Mechanical Engineers (ASME)
 - a. ASME A112.14.1 Backwater Valves
 - b. ASME A112.21.2M Roof Drains
 - c. ASME A112.36.2M Cleanouts
 - 2. ASTM International (ASTM)
 - a. ASTM A48 Standard Specification for Gray Iron Castings
 - b. ASTM A74 Standard Specification for Cast-Iron Soil Pipe and Fittings
 - c. ASTM D653 Standard Terminology Relating to Soil, Rock, and Contained Fluids
 - d. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - e. ASTM D2564 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
 - 3. International Plumbing Code and local amendments
 - 4. Manufacturers Standardization Society for the Valve and Fittings Industry (MSS)
 - a. MSS SP-58 Pipe Hangers and Supports – Materials, Design and Manufacture
 - b. MSS SP-69 Pipe Hangers and Supports – Selection and Applications

- c. MSS SP-89 Pipe Hangers and Supports – Fabrications and Installation Practices
- d. MSS SP-90 Guidelines on Terminology for Pipe Hangers and Supports

1.03 SUBMITTALS

- A. Product data for each type of product indicated
- B. Shop drawings showing piping layouts, sizes, types, valves, drains, and cleanouts
- C. Equipment manufacturer's printed operating and maintenance instructions including detailed parts list, recommended spare parts list, and complete operation and maintenance procedures
- D. Certified test results and certificates of compliance as necessary to verify conformance with specified requirements

1.04 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of an Independent Testing Laboratory.

PART 2 - PRODUCTS

2.01 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation
 - 2. Standard: ASME A112.14.1
 - 3. Size: Same as connected piping
 - 4. Body: Cast iron
 - 5. Cover: Cast iron with bolted or threaded access check valve
 - 6. End Connections: Hubless
 - 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed

8. Extension: ASTM A74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover

B. Drain-Outlet Backwater Valves

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products
2. Size: Same as floor drain outlet
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain
4. Check Valve: Removable ball float
5. Inlet: Threaded
6. Outlet: Threaded or spigot

2.02 CLEANOUTS

A. Exposed Cast-Iron Cleanouts

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company
 - b. Smith, Jay R. Mfg. Co.
 - c. Wade
 - d. Zurn Plumbing Products
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee
3. Size: Same as connected drainage piping for pipe sized less than NPS 4, NPS 4 for pipe sized NPS 4 to NPS 6, and NPS 6 for pipe sized larger than NPS 6
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping
5. Closure: Countersunk or raised-head, cast-iron plug
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size

B. Cast-Iron Floor Cleanouts

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company
 - b. Smith, Jay R. Mfg. Co
 - c. Wade
 - d. Zurn Plumbing Products
 - e. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout
2. Size: Same as connected drainage piping for pipe sized less than NPS 4, NPS 4 for pipe sized NPS 4 to NPS 6, and NPS 6 for pipe sized larger than NPS 6
3. Type: Heavy-duty, adjustable housing
4. Body or Ferrule: Cast iron
5. Clamping Device: Required
6. Outlet Connection: Threaded
7. Closure: Cast-iron plug
8. Adjustable Housing Material: Cast iron with threads
9. Frame and Cover Material and Finish: Stainless Steel
10. Frame and Cover Shape: Square
11. Top Loading Classification: Extra Heavy-Duty
12. Riser: ASTM A74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout

C. Cast-Iron Wall Cleanouts

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company
 - b. Smith, Jay R. Mfg. Co.
 - c. Wade.
 - d. Zurn Plumbing Products
2. Standard: ASME A112.36.2M. Include wall access
3. Size: Same as connected drainage piping for pipe sized less than NPS 4, NPS 4 for pipe sized NPS 4 to NPS 6, and NPS 6 for pipe sized larger than NPS 6

4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping
5. Closure: Countersunk or raised-head, drilled-and-threaded cast-iron plug
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size
7. Wall Access: Round, deep, stainless steel cover plate with screw

2.03 ROOF DRAINS

A. Cast-Iron Roof Drains

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company
 - b. Smith, Jay R. Mfg. Co.
 - c. Wade
 - d. Zurn Plumbing Products
2. Standard: ASME A112.21.2M
3. Pattern: High dome gutter drain
4. Body Material: Corrosion resistance cast iron
5. Dimensions of Body: Scheduled
6. Combination Flashing Ring and Gravel Stop: Required
7. Flow-Control Weirs: Where required
8. Outlet: Bottom or as indicated
9. Dome: Cast iron with corrosion resistant coating. Dome strainer shall extend a minimum of 4 inches above the roof or gutter surface.
10. Minimum Inlet Free Area: 24.5 square inches
11. Extension Collars: Required
12. Underdeck Clamp: Required
13. Sump Receiver: Required
14. Provide perforated stainless steel screen with removable cover where required.

B. Cast-Iron Roof Drains

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Froet Industries LLC
 - b. Josam Company

- c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Zurn Plumbing Products
2. Standard: ASME A112.21.2M, A112.6.4
 3. Pattern: Bifunctional roof drain with integral overflow drain
 4. Body Material: Corrosion-resistance cast iron
 5. Dimensions of Body: Scheduled
 6. Combination Flashing Ring and Gravel Stop: Required
 7. Flow-Control Weirs: Where required
 8. Outlet: Bottom or as indicated
 9. Dome: Cast iron with overflow strainer. Primary strainer shall extend a minimum of 4 inches above the roof surface.
 10. Minimum Inlet Free Area: 24.5 square inches
 11. Extension Collars: Required
 12. Underdeck Clamp: Required
 13. Sump Receiver: Required
 14. Provide perforated stainless steel screen with removable cover where required.

C. Cast-Iron Roof Drains

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company
 - b. Smith, Jay R. Mfg. Co.
 - c. Wade
 - d. Zurn Plumbing Products
2. Standard: ASME A112.21.2M, A112.6.4
3. Pattern: Scupper drain with angle grate
4. Body Material: Corrosion-resistance cast iron
5. Dimensions of Body: Scheduled
6. Combination Flashing Ring and Gravel Stop: Required
7. Flow-Control Weirs: Where required
8. Outlet: Bottom or as indicated

9. Dome: Cast iron with overflow strainer. Primary strainer shall extend a minimum of 4 inches above the roof surface.
10. Minimum Inlet Free Area: 24.5 square inches
11. Extension Collars: Required
12. Underdeck Clamp: Required
13. Sump Receiver: Required
14. Provide perforated stainless steel screen with removable cover where required.

2.04 TRENCH DRAINS

- A. Provide trench drains manufactured of heavy cast iron with double drainage patterns, sediment bucket, integral seepage pan and trap primer connection. Provide heel proof strainer of chrome plated, cast brass, polished brass or buff polished nickel alloy, as indicated, attached to a brass threaded collar for adjustment to varying floor thicknesses. Provide cast iron, extra heavy traffic pattern gutter or trench drains, where indicated. All strainers shall be vandal proof.

2.05 CAST-IRON AREA DRAINS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Josam Company
 2. Smith, Jay R. Mfg. Co.
 3. Wade
 4. Zurn Plumbing Products
- B. Standard: ASME A112.6.3.
- C. Pattern: Area drain heel proof
- D. Body Material: Gray iron
- E. Seepage Flange: Required
- F. Anchor Flange: Required
- G. Clamping Device: Required
- H. Outlet: Bottom
- I. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel
- J. Sediment Bucket: Stainless steel
- K. Top or Strainer Material: Stainless steel heel proof
- L. Top of Body and Strainer Finish: Polished bronze
- M. Top Shape: Square
- N. Dimensions of Top of Strainer: Scheduled

- O. Top Loading Classification: Extra heavy-duty
- P. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection

2.06 FLASHING MATERIALS

- A. Copper Sheet: ASTM B1542B/152M, 12 ounces per square foot thickness
- B. Zinc-Coated Steel Sheet: ASTM A653/A653M, with 0.20-percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D4068, flexible, chlorinated polyethylene, 40-mil minimum thickness
- D. Fasteners: Metal compatible with material and substrate being fastened
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed
- F. Solder: ASTM B32, lead-free alloy
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic

2.07 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Conductor Nozzles
 - 1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes
 - 2. Size: Same as connected conductor

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to installing or placing drainage products, insure excavations are free from water and extraneous material immediately therein.
- B. Clean interior of pipe, pipe fittings, drains, and cleanouts before installation.
- C. Install sleeves through walls, floors, roofs, and other structures before drainage lines are installed.

3.02 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 drainage piping sized NPS 4 to NPS 6 and NPS 6 for drainage pipe sized larger than NPS 6.
 - 2. Locate at each change in direction of piping greater than 90 degrees.
 - 3. Locate at minimum intervals of 50 feet for straight pipe runs.
 - 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 roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roof materials are specified in Division 07, Thermal and Moisture Protection.
 - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- E. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- F. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- G. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22, Plumbing Sections. Contract Drawings indicate general arrangement of piping, fittings, and specialties.

3.04 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0 pounds per square foot, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0 pounds per square foot, 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.05 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.

3.06 FIELD QUALITY CONTROL

- A. Testing
 - 1. Do not cover products to be embedded in concrete until inspections, testing, and acceptance of those products have occurred.
 - 2. Test installed storm drainage lines and equipment according to requirements for commissioning of plumbing in other sections, and as follows:
 - a. Provide and dispose of water required for testing
 - 3. Installation Verification: per commissioning of plumbing specified in other sections.

3.07 CLEANING

- A. Removing foreign material from the surfaces of products when cleaning. Leave the manufacturer's labels intact. Flush all sections of the piping system and dispose of the flushing water from the tunnel using temporary pumps where necessary.

3.08 COMMISSIONING

- A. It is the contractor's responsibility to apply for and secure all permits required by the City of Issaquah and the Issaquah Public Utility to drain into sewer or storm systems.
- B. Engage a factory-authorized service representative to train Sound Transit's maintenance personnel to adjust, operate, and maintain Storm Drainage Piping Specialties systems and equipment. See commissioning of plumbing in other sections for commissioning requirements pertaining to the work of this Section.

END OF SECTION

SECTION 22 14 29

SUMP PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes specifications for furnishing submersible oil minder pumps and motors at stations, elevator pit sumps and low-point pit sumps where indicated on the drawings.
- B. Elevator Pit Sumps and Low-Point Pit Sumps
 - 1. Furnish and install packaged submersible oil minder submersible pumps, automatic float switch, with appurtenances necessary to complete the work shown or specified herein. Obtain all pumps and appurtenances from one manufacturer. Pump and pump equipment shall be warranted by manufacturer for a minimum of five years.
 - 2. At elevator pit sumps, provide additional oil detection sensor and control system to detect floating oil and prevent pump operation.

1.02 REFERENCES

- A. Definitions
 - 1. BMS: Building Management System
 - 2. PLC: Programmable Logic Controller
 - 3. FM: Factory Mutual
 - 4. MCC: Motor Control Center
 - 5. NB: Northbound
 - 6. SB: Southbound
- B. Reference Standards: This Section incorporates by reference the latest revisions of the following documents.
 - 1. ASTM International (ASTM)
 - a. ASTM A48 Standard Specification for Gray Iron Castings
 - 2. American Society of Mechanical Engineers (ASME)
 - a. ASME 17,1 Safety Code For Elevators and Escalators.
 - 3. Insulated Cable Engineers Association (ICEA)
 - 4. National Electric Code (NEC)
 - 5. National Electrical Manufacturers Association (NEMA)

6. Hydraulic Institute Standards
 - a. ANSI/HI 9.8 Centrifugal and Vertical Pump Intake Design
 - b. ANSI/HI 11.6 Submersible Pump Tests
7. National Electrical Manufacturers Association (NEMA)
 - a. NEMA B Application and Installation Guidelines for Nonmetallic-Sheathed Cables
8. Submersible Wastewater Pump Association
9. Underwriters Laboratories (UL)
 - a. UL 778 Motor-Operated Water Pumps

1.03 PUMP SEQUENCE OF OPERATION

- A. Oil Minder Submersible Pump(s): Pump control system sequence of operation is as follows:
 1. Pump sequence applies to sump pumps at elevator pit sumps.
 2. During normal operations, sump pumps shall be ready in the automatic mode to start automatically if the water level is sensed by the level float sensor to be above the set point where pump needs to start and shut off when the water level goes below the set level where pump needs to stop.
 3. Continuous sump level shall be sensed by a locally mounted level transducer.
 4. When an initial increasing liquid level is sensed in the sump, the sump pump shall start and run until the level drops below a manufacturer required set point.
 5. Pump shall be capable of pumping water and preventing oily substances from entering sewer lines. If an oily substance is indicated a common alarm condition will be provided at Operations Control Center.
 6. When the pumps fails:
 - a. A float switch assembly shall indicate a low-level cutoff level and a high level alarm signal. If the sump level falls to the low level cutoff point, pump shall be unconditionally shut off.
 - b. The sump pump internal thermal switches shall indicate an alarm signal.

1.04 SUBMITTALS/TRANSMITTALS

- A. Submittals
 1. Certified copies of reports of factory tests specified in this Section or required by the referenced standards.
 2. Shop drawings with performance data and physical characteristics.
 3. Pump/motor performance charts showing curves for torque, current, power factor, input/output KW and efficiency.
 4. Manufacturer's operation and maintenance material and manuals

5. Provide technical details for control and power wiring of sufficient length for field installation inside the pump control enclosure. These wires come as pre-installed at pump motors and included in shipping package of the equipment specified in this Section.
6. Sump Controller
 - a. Shop Drawings: Submit shop drawings and electrical diagrams. Identify relay characteristics, including inrush current rating, on shop drawings.
 - b. Coordination Drawings: Floor plans showing dimensioned layouts, required working clearances, and required area above and around enclosed controller and filter where pipe and ducts are prohibited. Show enclosed controller and filter layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
 - c. Product Data: Submit manufacturer's product data of manufactured materials and equipment.
 - d. Load-current and list of settings of adjustable overload relays. Compile after motors have been installed and arrange to demonstrate DIP switch settings for motor running overload protection suitable for actual motor to be protected.

B. Transmittals

1. Manufacturer's installation instructions.

1.05 PROJECT COORDINATION

- A. Temporary Pumps: Coordinate the work of this section with the use of temporary pumps as necessary.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Promptly remove damaged products from the job site. Replace damaged products with undamaged products
- B. Thoroughly clean all equipment, components, and subassemblies of all water, sand, grit, weld splatter, grease, oil, and other foreign materials before preparation for shipment.
- C. Protect all machined surfaces against physical damage and exposure to the elements during shipment, handling, storage, and installation.
- D. Pack pumps to provide ample protection from damage during shipment, handling, and storage.
 1. Cap and seal all openings.
 2. Protect control and power wiring from insulation damage.

PART 2 - PRODUCTS

2.01 OIL MINDER SUBMERSIBLE PUMP UNITS

- A. Factory-assembled and -tested, single-stage, centrifugal, end-suction, automatic-operation, submersible oil minder pump unit shall be capable of pumping at the indicated

flow and pressure head required in the Contract Drawings. Pumping system including the pump, motor and power cable shall be approved for use in areas classified as hazardous locations in accordance with NEC Hazard Class I, Division I, Groups C and D, unless otherwise indicated.

- B. Pump Body and Impeller: Corrosion-resistant materials. Designed for floor mounting.
- C. Pump Seals: Mechanical type.
- D. Motor: Hermetically sealed, capacitor-start type, with built-in thermal overload protection. Comply with requirements herein.
- E. Power Cord: Three-conductor, waterproof cable of length required but not less than 72 inches (1,830 mm) and with grounding plug and cable-sealing assembly for connection at pump.
- F. Pump Controls: Pump manufacturer's simplex pump control panel, NEMA 4X enclosure, circuit breaker, motor contactor, control transformer, level control flow switch and high level float switch, run light, high level alarm light and horn with silence switch, one remote monitoring contact. Local LED indicator light shall be provided for the following:
 - 1. Oil detected
 - 2. High liquid level
 - 3. High amp or locked rotor motor condition
 - 4. Electrical power to panel
 - 5. Pump activation
- G. Oil Detection Control System: Pump manufacturer's controls to prevent pump operation when lighter-than-water oils are detected. Include NEMA 4X enclosure, stainless steel conductivity sensor probe, relays with sensitivity settings, alarm horn with alarm silencing switch, one remote monitoring contact.
- H. Include all manufacturer's inter-connecting power cables, sensor cables, control cables, probe cables, connecting plugs and receptacles. Provide adequate length of cable to run from the pump to the control panel.

2.02 LEVEL TRANSMITTER

- A. Solid-state, microprocessor-based, head pressure sensing, utilizing a variable capacitance transducer element suitable for continuously submerged operation.
- B. Unless otherwise indicated the submerged probes shall be approved for use in areas classified as hazardous locations in accordance with the NEC Class I, Div. 1, Group C and D service as determined and approved by a U.S. nationally recognized Independent Testing Laboratory (UL, FM).
- C. Housing: Type 316 stainless steel
- D. Sensors
 - 1. Rated for operation at negative 40 degrees F to 176 degrees F.
 - 2. Loop powered

- 3. Provide a 0- to 50-mVdc output signal in response to a field adjustable input span (0 to 30 pounds per square inch gauge maximum).
 - E. Polyvinyl chloride jacketed cable long enough to reach BMS panel without any splices.
- 2.03 FLOAT SWITCHES
- A. High density polyethylene float body
 - B. Approximately 4.5 inches in diameter
 - C. Mercury-to-electrode type tilt switch rated at 4.5 Amperes at 120 Vac
 - D. Float: Permanently marked to identify contacts as normally open or normally closed
 - E. Manufacturer: Anchor Scientific Inc. Type S or approved equal
 - F. Supply with heavy-duty No. 18/2 type SO cable with synthetic rubber or PVC jacket:
 - 1. Cable: Long enough to reach BMS panel or junction box in pump sump or pump room without any splices
- 2.04 WIRING
- A. Install in accordance with state and local electrical codes.
 - B. Ground equipment and devices in accordance with manufacturer's recommendations to prevent ground loops.
 - C. Control Wiring
 - 1. 24 V Circuits: Insulated copper 18 AWG minimum, rated for 300 Vac service
 - 2. 120 Vac
 - a. 14 AWG minimum, rated for 600 Vac service
 - b. Cable: Long enough to reach pump control panel without any splices

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of plumbing piping to verify actual locations of drainage piping connections before sump pump installation.

3.02 INSTALLATION

- A. Coordinate installation of sump pump motors and controls with other disciplines as necessary.
- B. Sump Pump Installation
 - 1. As indicated and according to manufacturer's written instructions.
 - 2. Lubricate all moving parts as recommended by the manufacturer's written instructions.

3. Anchor each pump securely with minimum embedment in solid concrete as indicated on Contract Drawings, Manufacturer's recommendations, or submit detailed calculation for approval of the Resident Engineer.
 4. Make all connections tight.
 5. Pumping Units: Level and plumb to ensure the units are uniformly supported.
 6. Test for ease of pump movement on slide rails before permanently securing discharge flange in place.
 7. Test for leakage at pump discharge flange.
- C. Nameplate: For each pump, located where it can be easily read.
- D. Cleaning: Clean grease, oil, or all other debris from the exterior surfaces of the pumps and motors.
- E. Control Installation
1. Coordinate with Instrumentation and Electrical regarding purchase, installation, and adjustment of controls.
 2. Bundle, train, and support wiring in enclosures.
- F. Level Sensors
1. Install low-level alarm float switch, high-level alarm float switch and level transducer in accordance with manufacturer's installation instructions for escalator pits. Install wiring to junction box indicated on the Contract Drawings.
 2. Locate pressure transducer in sump in accordance with manufacturer's installation instructions. Provide additional cable supports as required to located transducer.
 3. Adjust level transmitter and float switches to actuate at levels indicated.
- G. Access Requirements: Coordinate with type and location of access hatches and lifting device to ensure that pumps can easily be removed and serviced.
- H. Instruction: Arrange for manufacturer's service representatives to provide instruction in maintenance and operation activities.
- I. Provide temporary power to test pump installation.

3.03 CONNECTIONS

- A. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to state and local electrical codes.

3.04 FIELD QUALITY CONTROL

- A. Cleaning: After installation, thoroughly clean the wet well of all solids, dirt and other debris.
- B. Pump Tests
 1. Provide and dispose all water required for the testing. Use testing instruments calibrated by a qualified independent testing laboratory.

2. Test each pump in accordance with the manufacturer's written instructions and as specified in Contract Documents.
3. Field test each pump to establish field head and overall efficiency. Take voltage, power and amperage measurements for each test and include in the test report.
4. Run each pump individually for at least 20 minutes. Allow pumps to cycle through their normal operating sequence by operating them in automatic mode through the level control system. Provide all water required for testing at no additional cost to Sound Transit.
5. Record pressure with permanently installed gauges and flows with portable measuring equipment. Field test each pump, operating individually, by recording pressure and flow. The Flow rate may be measured by using portable measuring equipment or by noting the drop in the height of the water level in the sump during operation for a minimum period of time. The Resident Engineer will determine this minimum operation time period for calculating flow prior to the test. Record voltage, amps, power and power factor during all test modes of operation.
6. Trim pump impeller(s) to control flow rate if requested to do so by the Resident Engineer.

3.05 COMMISSIONING

- A. Engage a factory-authorized service representative to train Sound Transit's maintenance personnel to adjust, operate, and maintain sump pumps systems and equipment. Refer to commissioning of plumbing in other sections for commissioning requirements pertaining to the test and work of this Section.

END OF SECTION

Div 26

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SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for general electrical requirements that apply to other specification sections.

1.02 REFERENCES

A. This Section incorporates by reference the latest Authority Having Jurisdiction (AHJ) approved revisions of the following documents:

1. Institute of Electrical and Electronics Engineers (IEEE):
 - a. IEEE C2 National Electrical Safety Code (NESC).
 - b. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - c. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - d. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - e. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - f. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - g. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations.
2. National Electrical Contractors Association (NECA):
 - a. NECA NEIS 1 Standard Practice of Good Workmanship in Electrical Construction.
3. National Fire Protection Association (NFPA):
 - a. NFPA 70 National Electrical Code.
 - b. NFPA 70E Standard for Electrical Safety in the Workplace.
 - c. NFPA 110 Standard for Emergency and Standby Power Systems.
 - d. NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems.

4. State of Washington – Revised Code of Washington (RCW):
 - a. 19.27 RCW Washington State Building Code.
 - b. 19.28 RCW Electricians and Electrical Installations.
5. State of Washington – Washington Administrative Code (WAC):
 - a. 51-50 WAC State Building Code Adoption and Amendments of the International Building Code.
 - b. 296-45 WAC Safety Standards for Electrical Workers.
 - c. 296-46B WAC Electrical Safety Standards, Administration, and Installation.
6. Local City and AHJ Electrical Code.
7. Local City and AHJ Building Code.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Design and Bracing:

1. Equipment provided shall meet seismic requirements specified in the AHJ-approved building code. Provide suitable bracing and anchorage and submit calculations performed and sealed by a structural engineer registered in Washington.

1.04 SUBMITTALS

A. Submit:

1. List of Materials: Submit a list of materials and equipment proposed for use. Give name of manufacturer, brand name, and catalog number of each item. Submit the list complete at one time, with items arranged and identified in numerical sequence by Specifications Section and Article numbers.
2. Seismic Bracing and Anchorage Calculations.
3. Compliance with Applicable Standards:
 - a. Where equipment or materials are specified to conform to the standards of organizations such as ANSI, ASTM, IEEE, and NEMA, submit evidence of such conformance for review and record purposes.
 - b. The label or listing of the specified agency will be acceptable evidence.
 - c. Instead of the label or listing, the Contractor may submit a written certificate from an approved, nationally recognized testing organization, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified standard.
 - d. Submit evidence of compliance to seismic safety requirements of the Washington State Building Code, local amendments, and the National Electrical Code.
4. Factory Test and Inspection Certification.

5. Shop Drawings: Submit shop drawings showing equipment layouts and fabricated work being provided under these Specifications. Submit such drawings before rough-in work, fabrication, and within ample time to prevent delays in the Work. Include electrical diagrams for equipment and equipment installation.
6. Field Test Reports: Submit certified field test reports of field tests, verifying compliance of equipment and systems with Specification requirements.
7. Operation and Maintenance Manuals: Submit operation and maintenance instructions and data for equipment provided under this Division as required by the contract. Include recommended maintenance materials and spare parts list for installed equipment.
8. Sound Transit Cover Fasteners Keys: Submit ten key bits as described in Article 2.01.B.3, in this specification.

B. Transmit:

1. Qualifications of professional engineer

1.05 QUALITY ASSURANCE

- A. Qualifications: Ensure workers performing work meet the qualification and licensing requirements of Chapter 19.28 RCW.
- B. Perform work in compliance with the following industry standards and regulations if applicable:
 1. National Fire Protection Association:
 - a. NFPA 70 National Electrical Code.
 - b. NFPA 70E Standard for Electrical Safety in the Workplace.
 - c. NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems.
 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - b. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - c. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - d. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - e. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - f. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations.
 - g. IEEE C2 National Electrical Safety Code.
 3. NECA NEIS 1, Standard Practice of Good Workmanship in Electrical Construction.
 4. State of Washington Business Regulations and Administrative Codes.

5. Relevant amendments to Washington State regulations and codes adopted by local jurisdictions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. Furnish materials and equipment of design, sizes, UL listing (where UL standards exist), and ratings as indicated- suitable for the intended purpose.
2. Furnish materials and equipment acceptable to the authority having jurisdiction bearing label or classification listing of a nationally-recognized testing laboratory where product labeling or listing is available.
3. Methods of fabrication, assembly, and installation shall comply with specified Standards.
4. Provide products that are free from defects, which may impair performance, durability, or appearance.

B. Switches:

1. Provide ac, tumbler-type toggle switches conforming to minimum requirements of FS W-S-896, heavy-duty general use type.
2. Provide switches that operate in any position and are fully enclosed with entire body and cover of molded phenolic, urea, or melamine. Do not use fiber, paper, or similar flammable insulating material for body or cover.
3. Equip switches with metal mounting yoke with plaster ears, insulated from the mechanism and fastened to the switch body by bolts, screws, or other substantial means.
4. Provide the section of the yoke normally intended to bear on the surface outside the box with a minimum overall dimension of 3/4 inch, measured at right angles to the longitudinal axis of the yoke.
5. Use switch contacts of silver or silver alloy.
6. Use switches that are back or side wired with terminals of screw type or combination screw-clamp type.
7. Use terminal screws No. 8 or larger, captive or terminal type.
8. For use on lighting circuits, provide switches that are fully-rated for 20 A at 120 V or 277 V. Switches shall be gray color or as selected by Resident Engineer.
9. For control of resistive loads, switches may be snap-type as specified herein, of the proper rating up to 30 A at 120 - 277 V.
10. Provide 120 - 277 Vac snap switches capable of withstanding tests as outlined in FS W-S-896. If requested by Resident Engineer, submit evidence that the types of switches proposed have satisfactorily withstood these tests.

C. Receptacles:

1. Receptacle Standards: Ensure connector and outlet receptacles conform to FS W-C-596, heavy-duty general use type and NEMA WD6.
2. Convenience Receptacles:
 - a. Provide receptacles with fire-resistant, nonabsorptive, hot-molded phenolic composition bodies and bases and with metal plaster ears integral with supporting member. Color shall be as indicated in the Contract Documents.
 - b. Use receptacles that are 20R configuration, single- or duplex-type as indicated. Use receptacles that are back- and side-wired with screw or combination screw-clamp terminals.
 - c. For contacts of the receptacles, including the grounding contact, use double-grip bronze type with spring steel backup clips so that both sides of each male prong of the plug will be in firm contact.
3. Locking-Blade Receptacles: NEMA WD 6, configuration subject to approval.
4. GFCI Receptacles:
 - a. For ground fault circuit interrupter (GFCI) duplex receptacles use 120 V, 60 Hz, 20 A with built-in test and reset buttons and ground fault trip indicator.
 - b. Ensure they interrupt the circuit within 1/30 second on a 5 mA earth leakage current.
 - c. Receptacles shall also trip if the receptacle is incorrectly wired or if the ground-fault sensing/tripping unit fails.
 - d. Provide devices designed for end-of-run installation or with provisions for feeding through to protect other outlets on the circuit. Circuit capacity for feeding through shall be 20 A.
 - e. Provide receptacles with clamp-type terminals, mounting screws, and instructions.
5. Wallplates:
 - a. Provide multi-gang plates where required. Segmented wallplates are not acceptable.
 - b. Finished Area Device Covers: Brushed stainless steel, 0.040-inch thickness.
 - c. Utility Area Device Covers: Raised, galvanized steel
 - d. Exterior and Wet Location Cover:
 - 1) NEC-compliant "while-in-use" cover.
 - 2) Heavy-duty, die-cast aluminum, powder coated.
 - 3) Listed for wet locations, rated NEMA 250 Type 3R, with neoprene gasket.

- 4) Padlockable.
- 5) Depth: Minimum 3-1/4 inches.
- e. Damp Location Cover: Die-cast, copper-free aluminum listed for wet locations with self-closing spring door and rubber gasket.

2.02 SOURCE QUALITY CONTROL

A. Factory Test and Inspection Certification:

- 1. Where factory tests and inspections for materials and equipment specified in referenced documents are waived, submit certified copies of reports for tests performed on previously manufactured identical materials or equipment within the previous 12 months for review and approval.
- 2. Accompany test reports by signed statements from the manufacturer certifying that the previously tested material or equipment is physically, mechanically, and electrically identical to that proposed for the Contract. Include wiring and control diagrams.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with product listings, manufacturer's recommendations, relevant codes and regulations, and standard industry practice for electrical installations.
- B. Install electrical materials, equipment, appurtenances, and accessories in locations as indicated, in accordance with NECA NEIS 1, to provide a complete and operable system. Do not weld electrical materials for attachment or support.
- C. Provide anchor bolts and anchorage items as required, and field check to ensure proper alignment and location. Provide templates, layout drawings, and supervision at the jobsite to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.
- D. Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts, and angles as required to set and connect the work rigidly.
- E. Conform to the seismic restraint requirements of the AHJ-approved Building Code and Washington State Building Code.
- F. Ensure electrical equipment installed under these Specifications conforms to the AHJ-approved Building Code and the International Building Code Section 1621, Architectural, Mechanical, and Electrical Component Seismic Design Requirements.
- G. Control erection tolerance requirements so as to not impair the strength, safety, serviceability, or appearance of the installations.
- H. Install switches, receptacles, special purpose outlets, and cover plates complete in accordance with NECA NEIS 1, the National Electrical Code, and local electrical codes.
- I. Seal equipment enclosures against dust, whenever dusty conditions are present inside the rooms or outside, during the construction period.

3.02 CONSTRUCTION

A. Wallplate Type Requirements:

1. Public areas: Provide Finished Area device covers.
2. Non-Public areas: Provide Utility Area wallplates in ancillary spaces, mechanical rooms, fan rooms, electrical closets, electrical rooms, traction power substations, and unfinished areas.
3. Special purpose outlets: Provide Finished Area device covers of a design for the particular application.
4. Exterior and wet locations: Provide specified exterior and wet location while-in-use covers.
5. Damp locations: Provide specified damp location covers.

B. Wiring:

1. Provide wiring systems complete as indicated and required for proper service. Provide ample slack wire for motor loops, service connections, and extensions. In outlet or junction boxes provided for installation of equipment by others, insulate and protect ends of wires and cables and install blank covers.

C. Wiring Devices and Wall Plates:

1. Locate wiring devices at heights in accordance with NECA 1, except as otherwise indicated.
2. For exterior and damp locations including passenger stations, mount receptacles in watertight cast metal outlet boxes with threaded hubs or bosses.
3. Provide water-tight, locking-type male plugs protected by a ground-fault circuit interrupter for equipment subject to spray or hose cleaning.
4. Provide GFCI duplex receptacles where indicated.
5. Provide wallplates for each switch, receptacle, and special purpose outlet.

D. Interface With Other Work:

1. Coordinate the Work of this Section with the Work of others, as required to provide a complete and operable electrical installation.
2. Coordinate electrical services and Work with the serving utility company and Sound Transit, as applicable.
3. Coordinate with Work completed or in progress or to be performed under other Sections of these Specifications or by other contractors.
 - a. Make indicated connections to previously completed work.
 - b. Where future connections to or extensions of the work are indicated, provide safe and convenient provisions for such future connections and extensions.

END OF SECTION

SECTION 26 05 33

RACEWAY, BOXES, HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for furnishing and installing electrical raceways, underground electrical conduits, duct banks and utility structures, and equipment supports including conduit, duct and cable tray, outlet, junction and pull boxes, and electrical and communications distribution cabinets.

- B.** See Division 33 specifications for requirements for utilities electrical manholes and vaults. See Division 31 specifications for requirements for earthwork trenching and backfill.

1.02 REFERENCES

A. This Section incorporates by reference the latest revision of the following documents:

1. American National Standards Institute (ANSI):
 - a. ANSI C80.1 Electrical Rigid Steel Conduit (ERSC).
2. ASTM International (ASTM):
 - a. ASTM C33/C33M Standard Specification for Concrete Aggregates.
 - b. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - c. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. ASTM D1248 Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - e. ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
3. National Electrical Contractors Association (NECA):
 - a. NECA NEIS 1 Standard for Good Workmanship in Electrical Contracting.
4. National Electrical Manufacturers Association (NEMA):
 - a. ANSI/NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit, Electrical Metallic Tubing, and Cable.
 - b. NEMA FG 1 Fiberglass Cable Tray Systems.
 - c. NEMA RN 1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

- d. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Conduit.
 - e. NEMA TC 3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - f. NEMA TC 13 Electrical Nonmetallic Tubing (ENT).
 - g. NEMA TC 14 Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - h. NEMA VE 1 Metal Cable Tray Systems.
 - i. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
5. National Fire Protection Association (NFPA):
- a. NFPA 70 National Electrical Code.
 - b. NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems.
6. Underwriters Laboratories Standards (UL):
- a. BSR/UL 2024 Standard for Signaling, and Communications Raceways and Cable Routing Assemblies.
 - b. UL 1653 UL Standard for Safety Electrical Nonmetallic Tubbing.

1.03 SUBMITTALS

A. Submit the following:

1. Shop Drawings:

- a. Provide shop drawings showing the exact location and arrangement of conduits, cabinets, and pull-boxes installed under this contract.
- b. Provide shop drawings for fabrication and installation of precast concrete structures, cast-in-place concrete structures, and concrete-encased underground ductwork, including the following:
 - 1) Excavation and shoring plans with required structural calculations signed and stamped by a professional engineer registered in the state of Washington.
 - 2) Cast-in-place and precast detailed steel reinforcement drawings.
 - 3) Details of reinforcing steel used to tie duct bank to rigid underground structures it enters.
 - 4) Cast-in-place and precast manufacturer's concrete mix designs for structures and colored concrete as indicated.
 - 5) Dimensions and details of structure.
 - 6) Vault covers, including inscription.
- c. Shop drawing information may be combined on a single drawing if clarity is not thereby impaired.

- d. Submit shop drawings which fully demonstrate that the work to be performed and the materials to be provided comply with the provisions of these Specifications.

2. Conduit Fill Calculations:

- a. Provide conduit fill calculations for every conduit / conductor combination scheduled on the Contract Drawings or otherwise required to be installed for this project.
- b. Utilize actual conduit interior dimensions obtained from submitted product data complying with this Specification and conductor areas obtained from product data submitted under low-voltage electrical power conductor and cables requirements as required by the Contract as the basis for these calculations.
- c. Calculations shall demonstrate that the intended conduit type / size shall provide 20 percent surplus capacity for the installation of future conductors. For instance, in cases where the NEC conduit maximum fill percentage is 40 percent, the 20-percent surplus capacity would equate to a maximum 33 percent conduit fill.
- d. Calculations shall be provided for review prior to the scheduled installation of any conduit, to facilitate review. Calculations shall be reviewed and approved by Sound Transit prior to the installation of any conduit and wiring.

B. Transmit the following:

- 1. Provide a list of five (5) major projects for which similar products have been supplied, which have been in satisfactory use or operation for the past five (5) years.

2. Product Data:

- a. Provide product data for each type of material specified and proposed for use. Indicate the name of manufacturer, brand name, and catalog number of each item. Transmit the list complete at one time, with items arranged and identified in numerical sequence by Contract Specifications Section and Article numbers.
- b. Manufacturers' specifications and other data required to demonstrate compliance with these Specifications:
 - 1) Catalog cuts for the following products:
 - a) Raceways.
 - b) Duct bank tie-downs.
 - c) Underground duct system including manholes, pull boxes, conduit spacers, handholes, cable junction boxes, and termination boxes.
 - d) Manhole, pull box, and handhole covers and frames.
 - e) Related miscellaneous hardware and metal items for cable trenches and wireways.

- f) Trench and wireway covers including composition of

Fiberglass Reinforced Plastic materials, divider partition panels, method of joining sections, expansion joint mounting, and support details.

3. Compliance with Applicable Standards:

- a. Where equipment or materials are specified to conform to the standards of organizations such as ANSI, ASTM and NEMA, submit evidence of conformance. The label or listing of the specified agency will be acceptable evidence.
- b. Instead of the label or listing, the Contractor may submit a written certificate from an approved, nationally recognized testing organization, stating that the items have been tested and that the units conform to the specified standard.
- c. Accompany test reports by signed statements from the manufacturer certifying that the previously tested material or equipment is physically, mechanically, and electrically identical to that proposed for the Contract.

1.04 QUALITY ASSURANCE

A. Qualification of Manufacturers:

- 1. Select manufacturers of the products specified for work under this Section who are in the business of manufacturing similar products and are able to provide a history of successful production of the specified products.
- 2. Inspection: Ensure completed facilities are approved by the Resident Engineer before installation of cable and equipment. Perform corrective work at no additional cost to Sound Transit.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Precast concrete electrical boxes, pull boxes, and vaults:

- 1. Reinforce concrete in a manner which is regularly provided in standard products of the manufacturer.
- 2. Standard manufactured structures which meet project requirements will be acceptable.
- 3. Provide concrete inserts for mounting cable support brackets as indicated.
- 4. Provide pull box covers with two lifting eyes and two hold-down bolts.

5. In public and/or non-secure spaces, security shall be integrated in items including, but not limited to, electrical boxes, pull boxes, and vaults.
- B. Cast-In-Place Concrete for Duct bank Encasements, Manholes, Pull Boxes, and Vaults
1. Concrete: 3000 pounds per square inch with 4-inch slump in accordance with Portland cement concrete as required by the Contract.
 2. Red concrete: Portland cement concrete, using 100 pounds of iron oxide for 8 cubic yards of concrete, as required by the Contract.
 3. Frames, Covers, Gratings, Steps and Sumps: Provide as indicated and in accordance with Systems Standard Drawings and Contract Drawings.
 4. Cover Identification: Provide covers with embossed or engraved identification as indicated and in accordance with as required by the Contract.
 5. In public and/or non-secure spaces, security shall be integrated in items including, but not limited to, pull boxes, manholes, and vaults.
 6. In Manholes: Provide sump hole 1ft x 1ft for dewatering tasks.
- C. Sand:
1. Clean, graded, washed, passing a No. 4 U.S. sieve, and conforming generally to ASTM C33/C33M for fine aggregate.
- D. Warning tape:
1. Heavy gage, yellow, detectable plastic for direct burial, material resistant to corrosive soil, 6-inch minimum width, minimum 4 mils thick.
 2. Print with warning that an electrical duct bank is located beneath the tape.
 3. Install warning tape 12 inches below finished grade.
- E. Duct bank tie-down:
1. Non-metallic rod or stake with sufficient friction to prevent ducts from pulling rod out of ground and "floating" when concrete is placed.
- F. Raceway Supports:
1. Conduit clamps for individual conduit supports shall be one hole, galvanized heavy gauge steel, or galvanized malleable iron with clamp back. Channels, fittings and conduit racks shall be as specified in this Section.
- G. Channels and Fittings:
2. Hanger rods shall be high tensile strength galvanized carbon steel or electro-galvanized and zinc chromate coated steel with free running threads, 3/8 inch minimum.
 3. Channels and channel fittings, clamps and accessories shall be hot-dip galvanized, 12-gauge steel with holes 1-1/2 inch on center.
 4. Channels shall be 14 gauge minimum, 13/16 inch or 1-5/8 inch deep by 1-5/8 inch wide minimum.

5. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
6. Where heavy-duty racks are called out, channel shall be 12 gauge single or double 1-5/8 inch deep by 1-5/8 inch wide.
7. Aluminum, light gauge or low-strength metals or materials shall not be used.
8. Channel System Manufacturer: Unistrut, Powerstrut, Cooper B-line, Steel City, or approved equal as approved by Resident Engineer.

F. Anchors

1. Anchors shall be provided with sufficient strength to support four times the load as follows:
 - a. For hollow masonry, toggle bolts or masonry expansion anchors shall be used.
 - b. For solid masonry, brick, or pumice block, masonry expansion anchors shall be used.
 - c. For metal, machine screws, bolts, or welded studs with nuts and lock washers shall be used.
 - d. For wood, wood or sheet-metal screws shall be used.
 - e. For concrete, wedge type expansion anchors shall be used. Approved Product: Phillips Red-Head, Fastenal, or approved equal as approved by Resident Engineer.
2. Powder driven anchors or studs are prohibited for all applications.
3. Epoxy anchors are prohibited for all applications unless approved by Resident Engineer.

G. Fasteners and Hardware:

1. Fasteners and hardware shall be suitable for the use and environment intended. All fasteners shall be corrosion resistant. Plated steel fasteners may be used indoors, in dry locations, only. Unplated steel shall not be used.
2. Stainless steel fasteners shall be used in manholes, handholes, trenches and splice boxes, where exposed to weather, or in damp or wet locations. Bolted connections shall be made using lock washers.

H. Corrosion Control:

1. Material and equipment shall be designed to ensure satisfactory operation and life in the environmental conditions that exist where the material or equipment is installed.
2. Wherever "galvanized" or "hot-dip galvanized" is called out in this Section of the Specification, the material shall be coated in accordance with ASTM A123/A123M. Galvanneal finish is an acceptable alternative to hot-dip galvanizing of sheet or structural steel if cut edges are protected from corrosion. See Division 5 for shop applied coatings.

3. Wherever materials are called out as “hot-dip galvanized” or “galvanized”, the coating is intended to be applied in addition to normal manufacturer’s finish. Some materials or products specified, which are not readily available in the specified hot-dip finish, shall be “custom” hot-dipped after manufacture by an independent galvanizer. Where finishes are called out as galvanized and the specified product cannot be either manufactured with a hot-dip finish, or cannot be hot-dip galvanized after manufacture, the specified product shall be furnished with a finish that will perform equal to hot-dip galvanized as approved by Sound Transit.

K. Conduit and Duct:

1. Electrical Rigid Steel (Galvanized Rigid Steel – GRS) Conduit and Accessories: ANSI C80.1; hot-dip galvanized inside and out after threading; each length shall bear UL label:
 - a. Fittings and Accessories:
 - 1) Bushings: Nylon-insulated, metallic, grounding type.
 - 2) Sealing Bushings
 - a) Galvanized malleable or ductile iron bushings with Bakelite sealing and pressure discs and individual neoprene cable rings.
 - b) Bushings shall seal ends of GRS conduit against the entrance of water, air or dust around emerging cables.
 - c) Acceptable Manufacturer, Product: O/Z/Gedney, type KR or approved equal as approved by Resident Engineer.
 - 3) Conduit straps, clamps, and clamp backs: Galvanized malleable iron.
2. PVC-Coated Galvanized Rigid Steel Conduit (PVC/GRS): NEMA RN 1, with corrosion resistant internal coating.
 - a. Shipping: Thread protectors installed on both ends of conduit, with couplings packaged separately.
3. PVC Electrical Conduit and Fittings:
 - a. NEMA TC 2, EPC-40-PVC; heavy wall, high impact strength, rigid PVC.
 - b. Fittings: NEMA TC 3, EPC-40-PVC.
 - c. NEMA TC 2, EPC-80-PVC; heavy wall, high impact strength, rigid PVC for underground applications
 - d. Fittings: NEMA TC 3, EPC-80-PVC.
4. Epoxy and Phenolic Fiberglass Conduit and Fittings: NEMA TC 14; standard-wall and extra wall (XW):
 - a. Conduit joints and fittings: Tapered or untapered; all of one type.
5. Liquidtight Flexible Metallic Conduit and Fittings:
 - a. Core: Flexible galvanized steel with a continuous copper bonding conductor spiral wound between the convolutions.

- b. Jacket: Extruded liquidtight plastic or neoprene; moisture- and oil-proof, capable of conforming to the minimum radius bends of flexible conduit without cracking; self-extinguishing with low halogen containing material.
 - c. Fittings: Zinc-coated.
 - 6. Electrical Nonmetallic Tubing (ENT) and Fittings:
 - a. Listed UL 1653 and NEMA TC 13.
 - b. Fittings and outlet boxes shall be from the same manufacturer as ENT.
 - c. Outlet boxes shall be capable of supporting 50 pounds.
 - d. Mud boxes shall have threaded brass inserts.
 - 7. Conduit Expansion Fittings:
 - a. Factory installed packing ring, designed to prevent the entrance of moisture.
 - b. Pressure ring.
 - c. Grounding ring or a grounding conductor for metallic expansion couplings.
 - d. Use fittings which maintain a constant inside diameter in every position and provide a smooth wireway for protection of wire insulation.
- I. Innerduct:
 - 1. Smooth-wall HDPE innerduct, SD 13.5, meeting dimensional requirements of ASTM D3035 and material requirements of ASTM D1248.
 - 2. Nominal size: 1 inch, orange exterior color.
 - 3. Couplings: Pneumatic couplers specifically made for fiber blowing and capable of withstanding a pressure of 125 psi.
 - 4. Innerduct Sealing Plugs: High-impact, water-tight and gas-tight with elastic gaskets for sealing off innerduct after installation and proof-testing. Provide with end-to-end mule tape pull string.
 - 5. Carlon, Pyramid, Duraline or approved equal as approved by Resident Engineer.
- J. Galvanized Steel Field Coating:
 - 1. Organic cold galvanizing coating: minimum 95 percent metallic zinc by weight in dried film; manufactured by ZRC Products Company, or approved equal as approved by Resident Engineer.
- K. Oxide Inhibiting Joint Compounds:
 - 1. Petroleum-based compound with evenly suspended zinc particles.
 - 2. Burndy "Penetrox A" or approved equal as approved by Resident Engineer.
- L. Conduit Trapeze Hangers and Framing Channel:
 - 1. Hangers:

- a. Two or more steel hanger rods, a steel horizontal member, U-bolts, clamps, and other attachments as necessary for securing hanger rods, and conduits.
- b. Capable of supporting a load equal to the sum of the weights of the conduits and wires, the weight of the hanger itself, plus 200 pounds.
- c. Steel hanger rods: Galvanized, not smaller than 3/8-inch diameter, threaded either full length, or for a sufficient distance at each end to permit at least 1-1/2 inches of adjustment.
- d. Horizontal member:
 - 1) Structural grade steel, 1-1/2 by 1-1/2 inches or 1-5/8 by 1-5/8 inches, 12 gage, cold-formed, lipped channel, designed to accept special spring-held hardened steel nuts for securing hanger rods and other attachments. Ensure nuts and clamps are compatible with the channel.
 - 2) Two or more channels may be welded together to form horizontal members of greater strength.
 - 3) Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M, as applicable.
 - 4) Manufacturer: Unistrut or approved equal as approved by Resident Engineer.

M. Cable Trays:

- 1. Metal Cable Tray: NEMA VE 1, except for modifications indicated:
 - a. Components: Hot-dip galvanized steel in accordance with ASTM A123/A123M, or stainless-steel Type 304 or Type 316, as indicated.
 - b. Fiberglass cable tray: NEMA FG 1.
 - c. Dimensions: Use trays with a width of 6 inches minimum and a loading depth of 3 inches minimum. Use trays with an inside nominal depth of 5 inches minimum. Use curved fittings with a 24 inches minimum curve radius, unless otherwise approved by the Resident Engineer.
 - d. Type: Ladder type or solid bottom type with solid covers, as indicated.
 - e. Performance Requirements:
 - 1) Verify the cable tray system is capable of supporting a total cable load of 55 pounds per linear foot for cable tray of 30 inches wide or less and 88 pounds per linear foot for cable tray over 30 inches wide on a maximum span of 8 feet including a static concentrated load of 200 pounds as specified below, with a safety factor of two based on the destructive load, regardless of the type of splice plates or type of span, when tested in accordance with load test procedure specified in NEMA VE 1.
 - 2) Ensure that straight sections and fittings don't permanently deform under a 200-pound static concentrated load applied vertically along a 4-inch length for both of the following conditions:

- 3) Load applied to center of one tray section having specified cable load and support spacing. Apply load at midpoint between supports over a splice connection.
- 4) Load applied to one rung of empty tray section having specified support spacing. Locate the load at midpoint between side rails and supports.

2. Cable Tray Supports:

- a. Capable of carrying a working load of 100 pounds per linear foot, with a safety factor of 3.0 when loaded in accordance with NEMA VE 1, Section 3, and tested in accordance with NEMA VE 1, Section 4.
- b. Manufactured or fabricated in accordance with the cable tray manufacturer's recommendations.

N. Outlet Boxes, Junction and Pull Boxes:

1. Provide electrical boxes of the material, finish, type, and size indicated and as required for the location, kind of service, number of wires, and function.
2. Not all junction boxes are shown on the plans. Junction boxes and pull boxes shall be installed as necessary by the contractor to aid in pulling wire, and to be in conformance with NFPA 70. There shall not be more than a total of 270 degrees of conduit bends between pull points per Sound Transit criteria. Contractor is to coordinate the location of the junction boxes and pull boxes with other trades to ensure that the boxes will remain accessible after all construction is complete.
3. Provide boxes complete with accessible covers designed for quick removal and suitable for the purpose for which they will be used, except that boxes in which, or on which, no devices or fixtures are to be installed shall be equipped with flat or raised blank covers as required. All Junction and pull boxes with covers in publicly-accessible areas shall use tamper-resistant screws. See common work results for electrical as required by the Contract..
4. For boxes below 100 cubic inches in size or boxes for embedment in concrete use cast metal. Conform to the requirements for cabinets for boxes over 100 cubic inches in size, except when boxes in interface pull boxes are cast metal with gasketed cast metal covers. Use Type FD boxes for surface mounted wiring devices.
5. Pedestrian type junction boxes shall be used for applications that require a junction box to be embedded in floor concrete or grade. The junction boxes shall be designed to be mounted in sidewalks and other flat concrete surfaces. The boxes shall have checkered covers and be made to withstand pedestrian traffic. These boxes shall be provided with a flat, neoprene gasket, attached to the cover. This box shall be cast iron and the finish shall be hot dip galvanized. Cover shall be secured with tamperproof, uniquely-keyed stainless steel cover screws as described in common work results for electrical requirements as required by the Contract..
6. Ensure covers are the same thickness as boxes and are secured in position by means of No. 10-24 stainless steel machine screws set in recessed cover holes. Arrange covers to be readily and conveniently removed.

7. Ensure junction boxes are galvanized inside and outside. Where outlet boxes are used as junction boxes, do not use boxes smaller than 4 inches square by 1-1/2 inches deep. Provide such boxes with flat blank covers.
8. For exposed installation, use outlet and switch boxes made of cast metal, not smaller than 4 inches square by 2-1/8 inches deep.
9. Conduit bodies: Cast metal access pull and junction boxes: ANSI/NEMA FB 1, hot dipped galvanized cast iron, or electro-plated zinc cast iron, or stainless steel with gasketed cover.
10. Provide brackets, supports, hangers, fittings, bonding jumpers, and other installation accessories as required.
11. Provide neoprene gaskets 1/8-inch thick for boxes subjected to weather.
12. Ground each box as specified in grounding and bonding for electrical systems requirements, as required by the Contract.
13. Boxes for systems control and communications applications shall be stainless steel (grade 316) conforming to NEMA 250 Type 4X and shall be provided with appropriate labels.
14. All boxes for use in train ROW, exterior areas, exterior and interior non-conditioned spaces, and below grade (interior/exterior) areas shall be stainless steel, conform to NEMA 250 Type 4X (grade 316) and shall be labeled accordingly.
15. All junction boxes for use in conditioned interior areas shall be rated NEMA 12.
16. All junction boxes for use in escalator and elevator pits shall be NEMA 4X stainless steel (grade 316).
17. Coordinate location of boxes with equipment placement. Junction boxes shall be accessible for maintenance.

O. Enclosures:

1. Stations:
 - a. Comply with NFPA 70 and NFPA 130 for appropriate enclosure type for protection based on environmental conditions.
 - b. Exposed public areas subject to hose-down and splashing water shall be NEMA 4X stainless steel (grade 316).
 - c. NEMA 12 for indoor use in non-public areas.
 - d. Nonmetallic enclosures shall not be used.
2. Parking Garages:
 - a. Outdoor boxes shall be rated minimum NEMA 3R. Areas subject to hose-down and splashing water shall be NEMA 4X stainless steel (grade 316).
 - b. Comply with NFPA 70 for appropriate enclosure type for protection based on environmental conditions.
 - c. Stainless steel and plastic enclosure may be used. Plastic enclosures shall be made from a UV-stabilized polycarbonate.

P. Cabinets:

1. Cabinet Boxes: Galvanized (dry indoor locations) or NEMA 4X stainless steel (grade 316) (exterior and damp/wet locations), size as noted on Contract Drawings. Provide white, galvanized steel interior mounting panel for mounting terminal blocks and relays in interface terminal cabinets, or where otherwise required.
2. Cabinet Fronts: Steel, surface or recessed type as required for the application with continuous hinge and flush lock. Supply locks for cabinets from a single manufacturer with standard key blank that are field-keyable.
3. Electrical Service and Distribution Cabinets: NEMA 4X stainless steel (grade 316) with non-directional brushed finish and accessories shown on Contract Drawings. Provide metering provisions meeting the requirements of the serving electric utility for Service Cabinets or switchboard metering sections. Provide lock mechanism as required above.

Q. Cover Security in Public and/or Non-secure Spaces:

1. In public and/or non-secure spaces, security shall be integrated in items including, but not limited to, outlet boxes, junction boxes, pull boxes, and cabinet covers. Exception: In public areas that are secure during non-revenue hours, this requirement applies only to elements installed at an elevation lower than 10 feet above finished floor.
2. All boxes, enclosures, and cabinets shall have hardware and/or threading to accommodate the appropriate tamperproof, uniquely keyed fastener.
3. Cover fasteners shall be tamperproof, uniquely keyed for Sound Transit fasteners. The fastener shall be stainless steel and shall have the ability to repel locking pliers. The key shall be nonsymmetrical, custom, and unique to Sound Transit. Fastener key heads shall match existing Sound Transit keyed fasteners.
4. Provide Sound Transit with ten 1/4-inch hex drive key bits. (Bryce Key-Rex Fastener with Raptor Claw option or approved equal as approved by Resident Engineer.)
5. Provide covers with two tamperproof fasteners, or more as required.
6. Covers for boxes, enclosures, and cabinets in pedestrian areas shall have recessed areas for tamperproof fasteners.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before beginning construction or installation of a section of underground conduit or ductwork, verify that the site is in suitable condition for installing conduit or ductwork as indicated.

3.02 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform excavation, bedding, and backfilling for underground conduits and structures as stated elsewhere in the Contract Documents.

3.03 CONSTRUCTION

A. General Requirements:

1. Install electrical raceway, boxes and accessories in locations as indicated, in accordance with NFPA 70, (parking garages), NFPA 130 (stations and guideway), NECA NEIS 1 and manufacturer's instructions, to provide a complete and operable system.
2. Ensure conduit, support fittings, boxes and conduit fittings are of compatible materials that will not corrode when subjected to moisture or standing water.
3. Provide anchor bolts and anchorage items as required, and field check to ensure proper alignment and location.
4. Install conduit to avoid conflicts with other work. Install horizontal raceways close to the ceiling or ceiling beams and above water or other piping wherever possible. Conduit shall be installed concealed from public view.
5. Install metallic conduit such that it will not be in contact with standing water, wet weather or station hose-down cleaning activities.

B. Duct Banks:

1. Group individual conduits together to form a duct bank in conformance with the requirements as specified.
2. Inspect ducts and couplings to ensure that only clean and undamaged pieces are incorporated in the work.
3. Install ducts, joints, and use manufactured space separator assemblies according to manufacturer's printed instructions and recommendations.
4. Do not use spacers or space separators which transmit any vertical load to the conduit.
5. Install duct banks or conduits with a minimum slope of 3 inches to each 100 feet away from buildings and towards manholes, pull boxes, and handholes.
6. Terminate conduits and ducts in end-bells in vaults.
7. Where duct bank enters rigid underground structures, provide reinforcing steel to tie the duct bank to the structure.
8. Construct the concrete-encased duct bank with 3-inch minimum concrete cover on all sides.
9. Protection: when installation of conduits and ducts is temporarily suspended or terminated, close ends of ducts with caps or plugs fitted to prevent entry of water or debris. Use caps or plugs designed for that purpose by the conduit manufacturer.
10. Mandrelling: As each section of a duct line is completed between manholes, handholes, or pull boxes, use testing mandrel and brush to clear ducting:
 - a. For installations within the jurisdiction of Seattle City Light, perform mandrelling per the 2017 Seattle City Light Construction Standard, Standard Number U2-11.40/NDK-40.

b. For installation in other jurisdictions:

- 1) Draw mandrel not more than 1/4 inch less than the size of the conduit through each conduit, after which draw a brush with stiff bristles through until the conduit is clear of particles of earth, sand, or gravel.
 - 2) Install conduit caps or plugs immediately thereafter.
 - 3) Submit a written report providing a conduit identification number, size, material, location, the type and size of mandrel used, and indicate whether the conduit is tagged. Indicate on the report the acceptance date and the Contractor's foreman.
11. Install 1/8 inch or larger diameter polypropylene pulling cord in ducts including innerducts. Ensure accessibility for conduits with threaded caps, or fasten each cord to pull iron anchorage in pull box, manhole, or vault with 2 feet minimum slack.
 12. Maintain at least 1-1/2 inches of space between raceways for signal / communications duct banks and 3 inches for power.
 13. Set duct banks on undisturbed earth or compacted fill.
 14. Maximum of 16 raceways will be permitted in any one (1) duct bank where terminated in a single handhole or manhole.

C. Precast Concrete Structures:

1. Install precast electrical boxes, pull boxes, handholes, manholes, and vaults as indicated.
2. Manholes and handholes shall be of the precast type, complete with cable supports and pulling irons.
3. Provide a driven ground rod at each manhole or handhole, and ground all metallic parts.
4. Where installed in streets, provide traffic-rated cast iron cover and adjustable grade ring. Welded steel covers may be provided elsewhere.
5. Place boxes on 12-inch minimum of 3/4-inch minus crushed rock.
6. Place manholes on 12-inch minimum of 3/4-inch minus crushed rock.
7. Seal unused openings with cement mortar.

D. Cast-In-Place Concrete Structures:

1. Contractor shall ensure the location of each vault before construction of structure is started.
2. Construct the top, walls, and bottom of reinforced concrete. Construct the walls and bottom of monolithic concrete construction.
3. Place concrete for vaults on well-compacted soil with a minimum of 6 inches of aggregate base.
4. Provide gray cast iron frames and covers. Provide a machine-finished cover seat to ensure a matching joint between the frame and cover.

5. Where duct lines enter vaults, the sections of duct may be either cast in the concrete or may enter through a square or rectangular opening of suitable dimensions provided in the utility structure. Seal any openings used for conduit entry into vaults using a manufactured thru-wall sealing fitting or other similar approved method.
6. Provide a cable-pulling iron anchorage in the wall opposite each duct bank entrance.
7. Install vault covers flush with sidewalks or curbs.

E. Conduit and Duct Type Requirements:

1. Above grade exterior or potentially-wet areas: GRS or fiberglass conduit. Use GRS or XW fiberglass when above grade or in underground enclosed structures. Standard wall fiberglass is permitted for use in above ground areas that are concealed, not used for air handling, and where protected from damage.
2. Below grade spaces not fully enclosed (including tunnel passenger stations): PVC/GRS or low smoke zero halogen (LSZH) fiberglass conduit and accessories.
3. Conduits for emergency loads (such as emergency lighting and fire alarm system): GRS, XW fiberglass, or PVC/GRS, as required. In exposed tunnel locations, provide low smoke zero halogen (LSZH) phenolic fiberglass conduit to meet NFPA 130 requirements.
4. Below grade exterior areas: PVC/GRS conduit where direct buried or transitions to above grade, PVC and standard wall fiberglass electrical conduit encased in concrete duct banks, XW fiberglass conduit (see underground ducts and raceways for electrical systems, as stated elsewhere in the Contract Documents).
5. PVC electrical conduit may only be installed where covered with at least 3-inches of concrete, or where required in short sections for electrical isolation. Do not leave PVC conduit exposed unless specifically shown on Contract Drawings. Terminate PVC within concrete walls or slabs with a male adapter and PVC/GRS coupling installed flush with the finished surface.
6. Provide PVC/GRS conduit section for transition between an embedded conduit and the above-ground metallic conduit. Ensure that the above-ground PVC coated metallic conduit extends 1-foot minimum above ground or to box termination, whichever is less.
7. Install liquidtight flexible metal conduit only where required for flexibility such as connections to vibrating equipment and across joints subject to differential movement where the use of expansion-deflection fittings would not be suitable except where otherwise indicated on the Contract Drawing. Length shall not exceed 6 feet unless shown otherwise.
8. Flexible electrical nonmetallic tubing (ENT) is permitted for garage installations only when embedded in the concrete parking deck. Transition to GRS conduit where ENT conduit exits the slab. Exposed ENT shall not be permitted.
9. Running threads shall not be used.

F. Conduit Minimum Sizes:

1. Unless otherwise noted on drawings, minimum conduit sizes are as follows:

- a. GRS: 3/4-inch diameter for exposed locations and 1-inch diameter for embedded locations.
- b. PVC/GRS: 3/4-inch diameter for exposed locations and 1-inch diameter for embedded or underground locations

G. Raceways and Boxes:

- 1. PVC Conduit: 1-inch diameter for embedded or underground locations.
- 2. EB Duct: (where applicable): 4-inch diameter.
- 3. Epoxy or Phenolic Fiberglass Conduit: 3/4-inch diameter for exposed locations and 1-inch diameter for embedded locations.
- 4. Liquidtight Flexible Metallic Conduit: 1/2-inch diameter.
- 5. ENT: 1-inch diameter.
- 6. Conduit and Duct Bends:
 - a. Install conduit runs with not more than 270 degrees total bends between pull boxes. Where more bends are required in a run, install pull boxes as required to facilitate pulling conductors even if not indicated.
 - b. Minimum Bend Radius:
 - 1) Exposed or Embedded in Platform or Structure Slabs or Walls: NFPA 70 National Electrical Code Chapter 9, Table 2 – “Other Bends”.
- 7. Underground – Not in Station Areas:
 - a. 1-inch conduit: 18-inch radius.
 - b. 1-1/4-inch conduit: 20-inch radius.
 - c. 1-1/2-inch conduit: 22-inch radius.
 - d. 2-inch conduit: 24-inch radius.
 - e. 2-1/2-inch conduit: 27-inch radius.
 - f. 3-inch conduit: 30-inch radius.
 - g. 3-1/2-inch conduit: 33-inch radius.
 - h. 4-inch conduit: 36-inch radius.
 - i. 5-inch conduit: 42-inch radius.
 - j. 6-inch conduit: 48-inch radius.
- 8. Fiberglass and PVC Conduit Bending Restrictions:
 - a. Hot bend bends with radii less than 100 feet using a heater recommended by the conduit manufacturer. Bends with radius 100 feet or larger may be cold bent.

9. Horizontal bends in Schedule 40 PVC conduit shall have a bend radius not less than six feet, if conduit segment length (between pull points) is greater than 300 feet.

H. Conduit and Duct installation:

1. Install conduit in accordance with NFPA 70 (garages), NFPA 130 (stations and tunnels), local codes and ordinances and as indicated.
2. Prevent material and water from entering the conduit, or pull and junction boxes.
3. Provide threaded cap or similar closure designed for the purpose on conduits that are not terminated immediately. Tape is not acceptable for temporary sealing.
4. Match extensions to existing work to existing size.
5. Where conduit passes across an expansion or contraction joint in the structure, install the conduit at right angles to the joint, and an approved conduit expansion coupling or expansion/deflection fitting at the joint selected based on the expected movement of joint. Confirm with Resident Engineer.
6. Provide expansion fittings and slip collars at support points in conduit runs where required to compensate for thermal expansion.
7. Where conduit is exposed to different temperatures, seal the conduit to prevent condensation and passage of air from one area to the other.
8. If PVC conduit is not fully encased at one time, leave one end of the raceway free until encasing is restarted, or a PVC expansion joint is installed in the run.
9. When field threading of conduit is required, clean threads with a solvent to remove oil as recommended by coating manufacturer, and coat threads with organic cold galvanizing coating, in accordance with manufacturer's instructions.
10. Coat threads with oxide inhibiting compound for metal-to-metal threaded joints. Take care that compound is not present on interior of conduit after installation.
11. Seal conduits with watertight duct sealing system, where waterproofing is required.
12. Install liquidtight flexible metal conduit so that liquids tend to run off the surface and do not drain toward fittings. Provide sufficient slack to reduce the effects of vibration.
13. Terminate stubbed conduits for future use by inserting a male pipe plug with provisions for pulling cord attachment. Install wrench-tight into the flush coupling.
14. Mandrelling: As each section of a duct line is completed between pull boxes, use testing mandrel not more than 1/4 inch less than the size of the conduit and brush to clear ducting:
 - a. Draw mandrel through each conduit, after which draw through a brush with stiff bristles having a diameter of 1/2-inch greater than the internal diameter of the duct, until the conduit is clear of particles of earth, sand, or gravel.
 - b. Install conduit caps or plugs immediately thereafter.
 - c. Notify the Resident Engineer prior to mandrelling any conduit.

- d. Submit a written report providing a conduit identification number, size, material, location, the type and size of mandrel used, and indicate whether the conduit is tagged. Indicate on the report the acceptance date and initials of the Resident Engineer and the Contractor's foreman.
 15. Install 1/8-inch or larger diameter polypropylene pulling cord in ducts. Ensure accessibility for conduits with threaded caps, by tying cord to internal eye of conduit caps or by fastening each cord to pull anchorage in pull box, manhole, or vault with 2 feet minimum slack.
- I. Conduit Grounding and Bonding:
1. Install metallic conduits to be electrically and mechanically continuous and connected to ground by bonding to the grounding system.
 2. In dry areas, provide two (2) locknuts, one inside and one outside of box or enclosure and an insulated throat grounding bushing, for rigid conduit terminating at steel box, panelboard, cabinet, or similar enclosure.
 3. Conduit terminations in exposed areas and damp and wet locations:
 - a. Cabinet connections: provide watertight threaded hubs with sealing O-rings. Provide a positive ground connection for an external grounding conductor.
 - b. Cast boxes and fittings: provide threaded connections to tapered threaded hubs.
 4. Terminate the conduit in appropriate boxes at motors, switches, outlets, and junction points. Provide insulating bushing or grounding bushing on conduit end.
 5. See grounding and bonding for electrical systems, as stated elsewhere in the Contract Documents, for further requirements.
- J. Innerduct Installation:
1. Use glue and primer as recommended by manufacturer to withstand required 125 psi pressure. Apply glue and primer under dry conditions only.
 2. Install innerduct in accordance with manufacturer's recommendations to withstand required 125 psi pressure.
 3. Pressure test innerduct at 125 psi after installation and verify that it withstands and maintains the pressure and has no leaks. Submit test results to Resident Engineer for approval.
 4. Provide expansion fittings in innerduct runs where necessary or suggested by manufacturer to compensate for thermal expansion.
- K. Raceway Support:
1. Conduit supports shall be capable of supporting a load equal to the sum of the weights of the conduits and wires, the weight of the hanger itself, plus 200 pounds. Straps and clamps shall be listed for the task and made up tight to prohibit movement unless longitudinal movement is required due to conduit expansion.
 2. Where recommended by manufacturer to accommodate longitudinal movement due to thermal expansion, provide slip collars over conduits at support points.

3. Multiple runs of exposed conduit shall be grouped and supported on conduit racks constructed from channels, conduit clamps and fittings. Conduit racks shall be the trapeze style constructed from 1-5/8-inch by 1-5/8-inch steel channels, supported by 3/8-inch or 1/2-inch rods and concrete expansion anchors. Conduit racks shall be provided with 25 percent spare capacity, minimum.
4. Conduit racks may be used for support of vertical or horizontal conduit runs, except where otherwise specified. Conduit racks shall be braced in accordance with these Specifications to prevent sway in the event of a seismic event. Provide supplementary bolted stop-blocks below each conduit clamp in a vertical strut to assure that clamps cannot slide down the channel.
5. Where conduits 2 inch or larger nominal size are supported by racks, heavy-duty channel, clamps and accessories shall be used.
6. Support individual wall mounted horizontal conduits not larger than 1-1/2 inches in diameter by means of one hole conduit straps with back spacers or individual conduit hangers.
7. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
8. Space conduits installed against concrete surfaces 1/4 inch away from the surface by clamp backs or other approved means.
9. Support individual horizontal conduits larger than 1 1/2 inches nominal size by individual hangers.
10. Apply a thick coat of cold galvanizing coating to the field-cut ends of steel hanger rods and steel channel by brush. Coating may be done by spraying if at least 3 coats are applied per manufacturer's instructions.

L. Outlet, Junction, and Pull Boxes:

1. Securely attach outlet, junction, and pull boxes to the structure. Do not use conduits entering the box as supports for the box.
2. Mount outlet, junction, and pull boxes so as to prevent moisture from entering or accumulating within the boxes.
3. Junction and Pull Boxes:
 - a. Install so that covers are readily accessible after completion of the installation.
 - b. Do not install boxes above suspended ceilings, except where the ceiling is of the removable type or where definite provisions are made for access to each box.

M. Cable Trays and Supports:

1. Install cable trays as indicated using approved fittings and adequately supporting the complete system.
2. Use steel channels, threaded rods and hardware in accordance with raceways and boxes for electrical systems requirements.
3. Provide anti-sway brackets on horizontal tray assemblies in accordance with approved Seismic Bracing and Anchorage Plan (see common work results for electrical requirements as stated elsewhere in the Contract Documents).

4. Connect each isolated cable tray system or the entire tray system to the building equipment grounding system with a bare copper conductor routed throughout the tray system and bonded to each individual ladder section in accordance with all National Electrical Code requirements.
5. Provide expansion/deflection fittings in cable tray installations where they cross structure expansion joints and to accommodate differential expansion between cable tray and structure. Bond metallic cable trays across expansion/deflection fittings.
6. Provide stainless steel channel supports for all NEMA 4X stainless steel (grade 316) enclosures and boxes.

N. Installation of Concrete Expansion Anchors:

1. Concrete expansion anchors shall be used wherever a bolted attachment to solid concrete is required. Holes for anchors shall be drilled perpendicular to the concrete surface and the anchor installed in accordance with manufacturer's instructions.
2. Anchors installed at an angle to the surface, or anchors not fully seated, shall be replaced. Anchors shall not be spaced closer than 6 times the diameter of the hole, center to center.

O. Installation of Fasteners and Hardware:

1. The material, coating and finish of fasteners and hardware shall be suitable for the environment and use intended. Wherever fasteners exhibit corrosion at any time during the Contract, the fasteners or hardware shall be replaced with a suitable type as directed by Resident Engineer at no additional cost to Sound Transit.

P. Field Touch Up:

1. Perform on galvanized surfaces where required due to cutting or construction damage.
2. Brush coat with a zinc rich paint, after cleaning with a solvent to remove oil. Coating may be done by spraying if at least three coats are applied.
3. For finished surfaces in public areas, apply overall coat of compatible paint with color and surface texture matching adjacent surfaces.

3.04 INTERFACE WITH OTHER WORK

- A. Coordinate the work of this Section with the other electrical sections as stated elsewhere in the Contract Documents, as required to provide a complete and operable electrical installation.
- B. Coordinate electrical services and work with the serving utility company and the Resident Engineer, as applicable.
- C. Coordinate with work completed or in progress or to be performed under other sections of these Specifications or by other contractors. Make indicated connections to previously completed work. Where future connections to or extensions of the work are indicated, provide safe and convenient provisions for such future connections and extensions.
- D. Contract Drawings show electrical equipment, raceways, and other electrical facilities diagrammatically and do not show all accessories or fittings that may be required because of obstructing structural features and architectural finishes, interfering utilities, ducts, and mechanical equipment. Investigate such conditions and determine the need for locating

equipment and materials and routing electrical raceways clear of such obstructions and interferences. Provide complete and operable electrical systems and installations in conformance with these Specifications.

- E. Coordinate with work completed or in progress or to be performed under other sections of these Specifications or by other contractors or by designated subsequent contracts in the same space. Make indicated connections to previously completed work. Where future connections to or extensions of the work are indicated, provide safe and convenient provisions for such future connections and extensions.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for providing nameplates, wire and cable markers, conduit tags, conduit color coding, identification for raceway and metal clad cable, underground warning tape, warning labels and signs, and equipment identification labels.

1.02 SUBMITTALS

A. Submit:

1. Manufacturer's product data for nameplate mounting hardware.
2. Schedule for nameplates including list of wording, symbols, letter size, color coding, tag number, location, and function.
3. Samples: For each type of label and sign to illustrate size, color, lettering style, mounting provisions and graphic features.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Nameplates:

1. Engraved three-layer melamine laminated plastic, not less than 3/32 inch thick.
2. Color: Black letters on a white background unless otherwise noted.
3. Emergency equipment cabinets: Nameplates shall have white letters on an orange background in accordance with NFPA 70 code requirements.

B. Wire and Cable Markers:

1. Sleeves: Non-fading, waterproof, heat-shrink plastic, machine-printed sleeve labels.
2. Cable Tags: Non-fading, plastic, printed cable tag with holes for attachment to cable with nylon cable ties.

C. Conduit Tags:

1. Size: As noted for each application in this specification.
2. Type: Designed for permanent identification. Comply with ANSI A13.1 for minimum size of letters and minimum length of color field for each raceway and cable.

D. Mounting Screws: Stainless steel machine screws or rivets

- E. Mounting Adhesive: Permanent

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Nameplates and Identification Labels:
1. Degrease and clean surfaces to receive nameplates and identification labels.
 2. Install nameplates parallel to equipment and conduit lines.
 3. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to inside face of recessed panelboard or cabinet doors in finished locations.
- B. Cable Tags: Affix securely to cables and conductor bundles using compatible nylon cable ties.
- C. Conduit Tags: Comply with manufacturer's recommended installation procedures for a permanent installation.
- D. Wire and Cable Markers.
1. Heat-shrink wire and cable markers after final installation and testing.

3.02 CONSTRUCTION

- A. Identification Schedule:
1. Conductors:
 - a. Provide sleeve wire markers printed and installed in accordance with manufacturer's recommendations to identify each single and multiple-conductor wire and cable in panelboards, gutters, pull boxes, manholes, and at load connections.
 - b. In gutters, pull boxes, and manholes, if cables are not spliced, a cable tag shall be used. Attach tag securely to cable with nylon cable tie at location accessible and visible by personnel.
 - c. Identify cable destination and number of conductors in cable as described in Contract Drawings.
 - 1) Power and Lighting Circuits: Identify with branch circuit or feeder number.
 - 2) Control Wiring: Identify with control wire number as indicated on the Contract Drawings or fabricator's shop drawings.
 2. Conduit and MC Cable Identification:
 - a. Where accessible in canopy columns and light poles, provide tag identifying system type and identifier listed on conduit and conductor schedule. Attach tag securely with nylon cable tie.
 - b. Provide tags on conduits at conduit termination and access points.
 - c. For conduits with assigned raceway numbers, provide conduit tag matching conduit identification on Contract Documents. For multiple,

parallel raceways with one raceway identifier, assign supplementary letter designations for each raceway group.

- d. For conduits without assigned raceway numbers, provide generic conduit tag describing system (communications, signals, power lighting, etc.) plus identification of associated termination points.
 - e. Font Size:
 - 1) 3/4-inch tags: Minimum 36-point.
 - 2) 1-inch tags: Minimum 48-point.
 - 3) If exposed conduit length is not sufficient to accommodate these font sizes, reduce font to the maximum size possible, rotate tag at 90-degrees, or apply tag to equipment or box nearest conduit termination.
3. Provide nameplates of minimum letter height as scheduled below unless otherwise noted:
- a. Each disconnecting means shall be marked with an identification plate in letters at least 1/2-inch high.
 - b. Switchgear, Panelboards, Switchboards, and Lighting Controllers: 3/8 inch, identify equipment designation; 1/4-inch, identify voltage rating and source.
 - c. Disconnect Switches: 3/8-inch, identify equipment designation; 1/4-inch, identify voltage rating, source, and load served.
 - d. Individual Circuit Breakers in Panelboards: 1/4-inch; identify circuit with load served. For lighting, include the specific zone in the description if applicable on the schedule.
 - e. Motor Starters: 1/4-inch; identify circuit.
 - f. Individual Circuit Breakers, Enclosed Switches, and Motor Starters: 1/4-inch; identify load served.
 - g. Transformers: 3/8-inch; identify equipment designation. 1/4-inch; identify primary and secondary voltages, primary source, and secondary load and location.
 - h. Devices: 1/4-inch; identify device:
 - 1) Dimmers
 - 2) Control devices
 - 3) Pushbutton stations
4. Emergency Systems: For all boxes and enclosures larger than 6 inches by 6 inches (including transfer switches, central lighting inverters, and power panels) for emergency circuits, provide a permanent identification plate that is orange in color with white lettering. All other device and junction boxes for emergency systems and circuits shall be orange in color, both inside and outside.
5. Smoke Control Systems: For all boxes and enclosure larger than 6 inches by 6 inches (including transfer switches, central lighting inverters, and power panels)

for smoke control power and control circuits, provide a permanent identification plate that is orange in color with a yellow diagonal stripe. All other device and junction boxes for smoke control systems and circuits shall be orange in color, both inside and outside. Cover plates shall be orange in color with a yellow diagonal stripe.

6. Stair pressurization systems: For all boxes and enclosure larger than 6 inches by 6 inches (including transfer switches, central lighting inverters, and power panels) for stair pressurization power and control circuits, provide a permanent identification plate that is orange in color with a gray diagonal stripe. All other device and junction boxes for stair pressurization systems and circuits shall be orange in color, both inside and outside. Cover plates shall be orange in color with a gray diagonal stripe.
7. Non-Emergency Systems: For all boxes and enclosures larger than 6 inches by 6 inches for non-emergency circuits, provide a permanent identification plate that is black in color with white lettering.
8. Fire Alarm Systems: For all boxes and enclosures larger than 6 inches by 6 inches for fire alarm circuits, provide a permanent identification plate that is red in color with white lettering. All other devices and junction boxes for fire alarm systems and circuits shall be red in color, both inside and outside.
9. Concrete Paver Covering Electrical Handhole: Install ferrule inserts in four corners of pavers to identify location of handhole beneath paver where indicated on Drawings.

B. Conduit Color Coding:

1. Low-voltage and Medium voltage Distribution Systems: Unpainted or black
2. Fire Alarm System: Junction boxes / conduit bodies shall be substantially red in color both inside and out. Conduit and couplings shall be substantially red in color.
3. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors:
 - a. Color shall be factory applied or, for sizes LARGER than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no

tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION

SECTION 26 05 74

OVERCURRENT PROTECTIVE DEVICE, SHORT CIRCUIT AND ARC FLASH STUDIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for contractor to provide a computer-based time-current coordination, short circuit and arc-flash study to determine settings for overcurrent protective devices, verify that equipment and protective devices are applied within their ratings, and determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment. The study shall include the entire electrical system (both existing and proposed) for the facility.

1.02 REFERENCES

A. This Section incorporates by reference the latest revisions of the following documents.

1. Insulated Cable Engineers Association (ICEA):
 - a. ICEA P-32-382 Short Circuit Characteristics of Insulated Cables.
 - b. ICEA P-45-482 Short Circuit Performance of Metallic Shields and Sheaths on Insulated Cable.
2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. IEEE 141 Recommended Practice for Electric Power Distribution for Industrial Plants.
 - b. IEEE 242 Protection and Coordination of Industrial and Commercial Power Systems.
 - c. IEEE 399 Recommended Practice for Industrial and Commercial Power Systems Analysis.
 - d. IEEE 551 Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems.
 - e. IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations.
 - f. IEEE C57.12.00 General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - g. IEEE C57.96 Guide for Loading Dry-Tape Distribution and Power Transformers.
3. National Fire Protection Association:
 - a. NFPA 70E Standard for Electrical Safety in the Workplace.

B. Definitions:

1. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
2. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
3. SCCR: Short-circuit current rating.
4. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.03 SUBMITTALS

A. Transmit the following:

1. Product Data: For computer software program to be used for studies.
2. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.
3. Study input data, including completed computer program input data sheets. Provide after the approval of system protective devices submittals.
4. Qualification Data: Professional Engineer

B. Submit the following:

1. Study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Study shall include short circuit, selective coordination, and arc flash calculations.
 - b. Study shall include arc flash labels for all system busses that could be worked on in an energized state.
 - c. Provide study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Sound Transit for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
 - d. Study report at end of project to document as-built condition. Provide signed and sealed report, electronic copy, and all electronic source files from the power system modeling software.
2. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
3. Operation and Maintenance Procedures: Provide maintenance procedures for use by Sound Transit's personnel that comply with requirements in NFPA 70E.

1.04 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, perform analysis using the latest version of one of the following:
 - 1. Operation Technology, Inc. (ETAP).
 - 2. SKM Systems Analysis, Inc. (Power Tools for Windows).
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.02 STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 - 1. Protective device designations, ampere ratings and amp trip setting.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, panelboard, and enclosed breaker and switch designations.
 - 6. Utility source(s)
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit calculations: The calculation results shall include the following information:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each system bus and equipment location:
 - a. Voltage.

- b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- F. Protective device coordination study: The study results shall include the following information:
 - 1. Protective device trip curves for relays, electronic trip breakers, thermal magnetic breakers, fuses, overloads, etc.
 - 2. Trip settings for selectable trip devices.
 - 3. Trip settings for ground fault trip devices.
 - 4. Relay setpoint files for any electronic relays.
 - 5. Motor starting curves.
 - 6. Transformer inrush points.
 - 7. Generator damage curves.
 - 8. Time current coordination curves demonstrating selective coordination of all fault paths in the system.
- G. Arc-Flash Calculation: Calculation results shall include fault study input data, fault scenario descriptions, and fault-current calculations. The calculation results shall include definitions of terms and guidance for interpretation of computer printouts. The results shall include the following information for all buses and equipment in the system:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Working distance.
 - 6. Incident energy.
 - 7. Recommended personal protective equipment.
 - 8. Recommendations for arc-flash energy reduction.

2.03 ARC-FLASH WARNING LABELS

- A. Comply with requirements in identification for electrical systems as required by the Contract. Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall be in accordance with NFPA 70E. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Incident energy
 - 5. Working distance
 - 6. Engineering report number, revision number, and issue date
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Project overcurrent protective devices based on initial product transmittals, and for the as-built condition. Proceed with study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to study may not be used in study.

3.02 SHORT-CIRCUIT ANALYSIS

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. All devices and equipment in the electrical distribution system shall be included in the study.
- D. Analyze the electrical distribution system from normal and alternate power sources throughout electrical distribution system for the Project. Include studies of system switching configurations and alternate operations that could result in maximum fault conditions.
- E. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium voltage ac systems.
- F. Calculate short-circuit momentary and interrupting duties for three-phase bolted faults and single line-to-ground faults at all busses and equipment in the distribution system and note selected equipment deficiencies for the following:
 - 1. Electric utility's supply termination point.
 - 2. Substation primary and secondary terminals.

3. Switchgear and switchboards.
4. Motor-control centers and standalone combination motor starters.
5. Automatic and manual transfer switches.
6. Panelboards and control panels.
7. Disconnect switches and enclosed circuit breakers.
8. Transformer primary and secondary.

3.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399:
 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals. (Comply with NEC for selective coordination NFPA 70; 240.12, 620.62, 700.27, 701.18).
- C. Transformer Primary Overcurrent Protective Devices:
 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00 for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping or clearing time of over current protective devices including relays, circuit breakers and fuses. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- E. Coordination-Study Report: Prepare and submit a written report including the following information:
 1. Table of trip characteristics of fixed trip over current protective devices including thermal magnetic breakers and fuses.
 2. Table of trip settings for selectable trip Overcurrent Protective Devices including the following information:

- a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Ground-fault relay-pickup and time-delay settings.
 - 3. Trip curves for all overcurrent protective devices in the system.
 - 4. Trip curves for utility protective devices.
 - 5. Coordination Curves: Time Current Curves (TCC) shall demonstrate selective coordination for all fault paths in the distribution system. TCC's shall graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Provide TCC for all fault paths in the system and terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.
 - 6. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Motor starting curves.
 - h. Generator damage curves.
 - i. Maximum fault-current cutoff point.
 - F. Provide completed data sheets for setting of overcurrent protective devices bound in a 3-ring binder.
 - G. Provide electronic settings data file for all relays.
- 3.04 ARC-FLASH HAZARD ANALYSIS
- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
 - B. Use the short-circuit and coordination analysis results as input data.
 - C. Calculate maximum and minimum fault-current scenarios:
 - 1. The minimum fault current scenario shall assume that the fault contribution from all sources is at a minimum and motor are not running.

2. The maximum calculation shall assume a maximum fault contribution from all sources and shall assume all motors are operating at full-load.
- D. Calculate the arc-flash protection boundary and incident energy at all buses and locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- G. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
 1. When the circuit breaker is in a separate enclosure.
 2. When the line terminals of the circuit breaker are separate from the work location.
- H. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.
- I. Indicate recommended personal protective equipment at all busses and equipment in the system.

3.05 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis:
 1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Engineer of Record.
 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study.
 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams,

overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. Motor horsepower and NEMA MG 1 code letter designation.
11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.06 LABELING

A. Apply arc-flash labels for all applicable electrical equipment including the following:

1. Utility service equipment.
2. Panelboards.
3. Disconnects.
4. Enclosed circuit breakers.
5. Automatic and manual transfer switches.
6. Motor-control centers.
7. Combination motor starters.
8. Low-voltage switchboards.
9. Switchgear.
10. Medium-voltage switches.
11. Control panels.

12. Transformer primary and secondary.
13. Load equipment such as HVAC equipment and any other equipment requiring servicing, adjustment or inspection while energized.

3.07 APPLICATION OF WARNING LABELS

- A. After Sound Transit approval of the arc flash study, install the arc-fault warning labels under the direct supervision and control of the Arc Flash Study Specialist.

3.08 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Sound Transit's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section excludes:

1. Requirements for train control house system electrical equipment and traction power substation commissioning as this is governed under Section 01 91 13 - General System Testing and Commissioning Requirements.

B. Section includes:

1. Requirements for commissioning process requirements for electrical systems:
 - a. Level 1 commissioning activities for electrical systems.
 - b. Level 2 commissioning activities for electrical systems.
 - c. Support for Level 3 commissioning activities related to electrical systems.
 - d. Support for Level 4 commissioning activities related to electrical systems.
 - e. Providing qualified personnel to assist in commissioning tests.
 - f. Providing equipment, materials, and labor necessary to correct issues found during the commissioning process, which fulfill contract and warranty requirements.

1.02 REFERENCES

A. This Section incorporates by reference in individual sections of Division 26 the latest revisions of the following documents and standards. Refer to individual specification sections for greater detail:

1. NACE International.
2. Institute of Electrical and Electronic Engineers (IEEE).
3. National Fire Protection Association (NFPA).
4. International Electrical Testing Association (NETA).
5. National Institute of Standards and Technology (NIST).
6. Underwriters Laboratories (UL).
7. American National Standards Institute (ANSI).
8. National Electrical Manufacturer's Association (NEMA).
9. ASHRAE Guideline 0-2005, The Commissioning Process (including Amendments)

B. Definitions:

1. Refer to Section 01 91 13 - General System Testing and Commissioning Requirements for commissioning definitions.

1.03 COORDINATION

- A. Refer to Section 01 91 13 - General System Testing and Commissioning Requirements for general coordination requirements related to commissioning.

1.04 COMMISSIONING ACTIVITIES

- A. Commissioning work furnishes labor and material to accomplish building commissioning as specified in the Contract Documents and in this specification, including:
 1. Review General Requirements outlined in Section 01 91 13 - General System Testing and Commissioning Requirements.
 2. Provide to the Sound Transit Testing and Commissioning Manager preliminary operations and maintenance information for submittal.
 3. Assist the Sound Transit Testing and Commissioning Manager in developing commissioning activity procedures and data forms submittals for work specified in this Section.
 4. Provide information to the Testing and Commissioning Manager needed for control interface wiring diagrams submittals for the work of this Section.
 5. Perform Level 1 commissioning activities specified in this Section, including installation verification, static tests, start-up, component tests, equipment tests, systems tests.
 6. Perform Level 2 commissioning activities specified in this Section, including intra-station system interface tests.
 7. Provide support for Level 3 commissioning activities, including jointly with the communications system contractor field testing points in the interface terminal strips, being present during level 3 testing with sufficient labor and support personnel to adjust equipment and troubleshoot system failures that might arise. When material or equipment provided by this Division is found to be in conflict with specified criteria, adjust or replace said material or equipment, with the assistance of manufacturer as needed.
 8. Provide support for Level 4 commissioning activities, including providing sufficient labor and support personnel to adjust equipment and troubleshoot system failures that might arise during pre-revenue testing.
 9. Operate equipment and system during commissioning activities as required by the Testing and Commissioning Manager.
 10. Perform and document commissioning tests to verify readiness for commissioning test demonstration. Commissioning tests are specified in this specification.
 11. Correct issues and repeat commissioning tests when results do not meet acceptance criteria.
 12. Perform commissioning test demonstration specified in this specification to verify acceptable performance.
 13. Record and submit commissioning test demonstration data and issues.

14. Correct issues and repeat commissioning test demonstration when results do not meet Acceptance Criteria.
 15. Attend commissioning meetings as requested by the Sound Transit Testing and Commissioning Manager.
 16. Report any inconsistencies or issues in system operations or performance.
 17. Provide personnel to support commissioning test demonstration specified in this specification as requested by the Sound Transit Testing and Commissioning Manager.
 18. In the event that a commissioning test demonstration fails, assist in determining the cause of failure. Make corrections.
 19. Cooperate with Testing and Commissioning Manager to make equipment and systems ready for commissioning tests specified in this specification as early in the construction schedule as possible.
 20. Provide factory start-up services for key equipment and systems specified in Division 26. Coordinate this work with the manufacturer and the Testing and Commissioning Manager.
 21. Complete all phases of work so the system can be started, tested, balanced, and otherwise commissioned. Division 26 has start-up responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation of all equipment and materials per the contract documents and related directives, clarifications, change orders.
 22. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and sub-systems, if expediting this work is in the best interests of Sound Transit. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems.
- B. Cooperate with the Sound Transit Testing and Commissioning Manager to accomplish commissioning work on schedule and in coordination with other trades.

1.05 QUALITY ASSURANCE

- A. Coordinate completion of Installation Verification forms, by the Quality Control Inspector, as identified in the Contractors Quality Control Inspection and Test Plan.

1.06 LABELS

- A. Upon completion of tests by a testing firm, a NETA label shall be attached to all serviced devices. These labels shall indicate date serviced and the testing company.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide test equipment and instrumentation, including consumable supplies, required to execute commissioning activities. Unless noted otherwise, test equipment and instrumentation remain the property of the Contractor.
- B. Standard certified test equipment for commissioning shall be provided by Division 26.

2.02 PROPRIETARY TEST INSTRUMENTS

- A. Provide proprietary test instruments or tools required by the equipment manufacturer. Provide and operate the proprietary test instruments or tools as required for commissioning work.

PART 3 - EXECUTION

3.01 PARTICIPATION IN COMMISSIONING

- A. Provide skilled technicians to start-up and debug all systems with the division of work. These same technicians shall be made available to assist the Sound Transit Testing and Commissioning Manager in completing the commissioning program as it relates to each system and their technical specialty. Work schedules and time required for testing shall be requested and coordinated by the Sound Transit Testing and Commissioning Manager. Contractor shall ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and problem resolutions.

3.02 LEVEL 1 COMMISSIONING ACTIVITIES REQUIREMENTS

- A. Level 1 commissioning activities scope: Technical requirements for commissioning of electrical systems are specified in this specification.
- B. Provide technicians, instrumentation, and tools to perform commissioning activities in accordance with accepted commissioning activity procedures at the direction of the Sound Transit Testing and Commissioning Manager.
- C. Scope of electrical systems commissioning activities applies to all portions of the electrical systems installation described in the test.
- D. Preparation:
 - 1. Certify that electrical systems, subsystems, and equipment have been completed, calibrated, and started; and are operating in accordance with Contract Documents.
 - 2. Ensure that all enclosures for electrical equipment are clean and debris free.
 - 3. Ensure that all enclosures for electrical equipment or conductors that are located in public and non-secure spaces have covers that are secured with the appropriate tamperproof, uniquely keyed fastener.
 - 4. Ensure that all enclosures for electrical equipment or conductors have identification nameplates.
 - 5. Testing Instrumentation: Install measuring instruments and logging devices to record test data in accordance with accepted commissioning test procedures as directed by the Testing and Commissioning Manager.
 - 6. Certify that electrical systems instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.
 - 7. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions) in accordance with accepted commissioning test procedures as directed by the Testing and Commissioning Manager.

- E. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- F. Tests will be performed using design conditions whenever possible.
- G. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Provide equipment to simulate loads. Set simulated conditions in accordance with accepted commissioning test procedures as directed by the Testing and Commissioning Manager. Document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- H. Request approval to alter set points when simulating conditions is not practical.
- I. Request approval to alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical.
- J. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to the Resident Engineer. After deficiencies are resolved, reschedule tests.

3.03 LEVEL 1 AND LEVEL 2 COMMISSIONING ACTIVITY PROCEDURES

- A. Submit level 1 commissioning activity test procedures and data forms for the following types of commissioning activities, requirements for which are specified in this specification:
 - 1. Level 1 commissioning activities:
 - a. Installation verification
 - b. Static tests
 - c. Start-up procedures
 - d. Component tests
 - e. Equipment tests
 - f. System tests
- B. Cooperate with the Testing and Commissioning Manager to develop level 2 commissioning activity test procedures and data forms related to the work of this Division. Provide information as needed, including interfaces with equipment and systems installed by others:
 - 1. Level 2 commissioning activities:
 - a. Intra-station system interface tests.

3.04 LEVEL 1 INSTALLATION VERIFICATION REQUIREMENTS

- A. Scope: Installation verification checklists are required for the following, at minimum:
 - 1. 2608-IV-01 Power wires, conductors, and cables:
 - a. Low voltage.
 - b. Medium voltage.
 - 2. 2608-IV-02 Grounding and bonding for electrical systems.

3. 2608-IV-03 Transformers:
 - a. Low voltage transformers.
 - b. Dry-type medium voltage transformers.
4. 2608-IV-04 Medium voltage metal clad switchgear.
5. 2608-IV-05 Switchboards.
6. 2608-IV-06 Panelboards.
7. 2608-IV-07 Circuit breakers:
 - a. Molded-case Circuit Breakers (60 amps and above, 3-phase).
 - b. Low Voltage Power Circuit Breakers.
 - c. Medium Voltage Power Circuit Breakers.
8. 2608-IV-08 Motor control centers.
9. 2608-IV-09 Motor Control Equipment (FVNR, Soft-Start and VFD).
10. 2608-IV-10 Protective Device Relays.
11. 2608-IV-11 Instrument Transformers.
12. 2608-IV-12 Metering and Instrumentation.
13. 2608-IV-13 Central battery inverter.
14. 2608-IV-14 Batteries.
15. 2608-IV-15 Static uninterruptible power supply.
16. 2608-IV-16 Lighting systems:
 - a. Exterior lighting systems:
 - 1) Verify the CCT (correlated color temperature).
 - b. Interior lighting systems:
 - 1) Verify the CCT (correlated color temperature).
 - c. Exit Sign.
 - d. Lighting Control Panels.
 - e. Control devices:
 - 1) Occupancy sensor.
 - 2) Vacancy sensor.
 - 3) Daylighting Controls.
 - 4) Photocell.
 - 5) Manual light switch.

17. 2608-IV-17 Photovoltaic Collectors.
 18. 2608-IV-18 Electric Vehicle charging systems.
 19. 2608-IV-23 Transfer Switches:
 - a. Manual Transfer Switch.
 - b. Automatic Transfer Switch.
 20. 2608_IV-24 Enclosed Switches, Fuses and Disconnects.
 21. 2608_IV-25 Generators:
 - a. Standby Generator.
 - b. Generator's plug receptacle.
- B. Installation Verification Scope: Technical requirements for Installation Verification of electrical systems are specified in this specification.
- C. Installation verification checklist forms shall include the following:
1. Organized to prompt the installer to check off quality criteria for each discrete portion of the Work.
 2. Identify the system or features to which the installation verification checklist applies at the top of the form.
 3. Section for verification of delivery of accepted materials.
 4. Section for condition of materials at delivery.
 5. Section for description of installation steps. Include manufacturer's installation instructions.
 6. Space at the end of the form for the installer to print their name and company name, fill in the date, and sign or initial.
 7. Space at the end of the form for the Quality Control inspector designated for the scope to review and accept installation verification. QC Inspector must perform Install Verification and verify each element identified in form has been reviewed for conformance with contract documents and in accordance with the Contractors Quality Control Inspection and Test Plan as part of Section 01 45 00 - Quality Assurance/Quality Control.
 8. Space to identify the area of work for which the installer is executing the Installation Verification Checklist.
 9. Description of the quality criteria as it pertains to the specific work. Include a checkbox for each criterion.
- D. Quality Criteria: Installation verification checklists shall address the following quality criteria:
1. Make and model match accepted submittals.
 2. Equipment is installed without visible damage.
 3. Location is as indicated on Contract Drawings.

4. Equipment is accessible for maintenance using safe work practices.
 5. There is sufficient space to remove and replace components intact without demolishing other work.
 6. Identification of components is legible and located to be visible.
- E. Fill out and sign installation verification checklists for electrical systems while the Work is being installed. The intent is for the installing tradesperson to fill out and sign the installation verification checklist as work proceeds to improve the quality of the installation. Retain completed installation verification checklists on site for review.
- F. Before performing a commissioning test, installation verification checklists must be performed and completed by QC inspector designated for the appropriate area specified here in and within the Contractors Quality Control Inspection and Test Plan as part of 01 45 00. Submit completed installation verification checklists for work included in the commissioning test.

3.05 LEVEL 1 STATIC TESTS

- A. 2608-ST-01: Insulation Resistance:
1. System/Equipment to be tested:
 - a. Insulation of conductors rated 100 amperes or greater.
 - b. Insulation of conductors for all motor loads.
 - c. Insulation of heat trace conductors.
 2. Functions to be tested:
 - a. Insulation resistance.
 3. Conditions of the Test:
 - a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts DC for 300 volt rated cable and 1000 volts DC for 600 volt rated cable.
 - b. Test duration shall be one (1) minute.
 - c. Include in Static Test Procedures and Data Forms submittal.
 - d. Test conditions for heat trace per manufacturer's test procedures.
 4. Acceptable Results:
 - a. Insulation resistance tests shall meet the requirements of Exhibit A, Table 26 08 00 - A3.
 - b. Heat trace acceptance values per manufacturer's test procedures.
- B. 2608-ST-02: Bolted Connection Torque:
1. System/Equipment to be tested:
 - a. Bolted connections for conductors rated 100 amperes or greater.
 2. Functions to be tested:

- a. Bolted connection torque.
- 3. Conditions of the Test:
 - a. Perform torque test for each conductor tested and terminated in an overcurrent device or bolted type connection.
 - b. Include in Static Test Procedures and Data Forms submittal.
- 4. Acceptable Results:
 - a. Bolted connection torque values shall meet the manufacturer's published values or the requirements of Exhibit A, Table 26 08 00 - A2.
 - b. Record the Acceptable Results for O&M documentation.
- C. 2608-ST-03: Ground Resistance:
 - 1. System/Equipment to be tested:
 - a. Grounding resistance.
 - b. Reference: Grounding and bonding for electrical systems as stated in the Contract Documents.
 - 2. Functions to be tested:
 - a. Grounding resistance.
 - b. Ground continuity.
 - 3. Conditions of test:
 - a. Test the grounding system by the fall-of-potential method.
 - 4. Acceptable Results:
 - a. Station grounding system: 10 ohms, maximum.
 - b. Communications and Train Control System grounding electrode: 25 ohms, maximum.
 - c. Traction Power Substation: 5 ohms, maximum.
 - d. Tie Station grounding electrode: 5 ohms, maximum.
 - e. OCS Foundation: 25 ohms, maximum.
 - f. OCS Foundation with surge arrester: 5 ohms, maximum.
- D. 2608-ST-04: Lighting Systems Illuminance Levels:
 - 1. Equipment/Systems to be tested:
 - a. Lighting Levels throughout.
 - 1) Normal circuits.
 - 2) Emergency circuits.
 - b. Lighting Levels with dimming, occupancy, and daylighting sensor.

- 1) Normal circuits.
 - 2) Emergency circuits.
2. Functions to be tested:
 - a. Measure footcandle levels at random locations of the floor area. Include area outlined in Table 1007-4, Table 1007-5, and Table 1007-6 in the Requirements Set 1007.
 - b. Measurements shall be taken to the following areas specified in the Table 1007-4, Table 1007-5, and Table 1007-6 in the Requirement Set 1007 and documented.
3. Conditions of Test:
 - a. Areas are complete, cleaned, and no obstructions such as construction debris where the light measurement will be taken from.
 - b. For exterior lighting, measurement must be taken when sky is completely dark.
 - c. Measurement must be taken between light fixtures, and not under the light fixture:
 - 1) Few measurements must be taken when the light level requirement specified average.
4. Acceptable Results:
 - a. Light levels meet the requirement specified in the Table 1007-4, Table 1007-5, and Table 1007-6 in the Requirements Set 1007.
 - b. Provide floor plan and indicates where the measurement is taken.
- E. 2608-ST-05: Circuit Continuity and Phase Relationship:
 1. Equipment/Systems to be tested:
 - a. Branch circuits and feeders throughout.
 2. Functions to be tested:
 - a. Measure circuit continuity, phasing, and phase rotation at random locations of the floor area. Measurements shall be taken at the following areas and documented.
 - 1) All lighting circuits.
 - a) Normal circuits.
 - b) Emergency Egress circuits.
 - 2) All power branch circuits:
 - a) Normal circuits.
 - b) Emergency or Critical circuits.
 - 3) Elevator Machine and Escalator Motor Feeders.

- 4) Electrical Rooms Switchboard and Panelboard Feeders.
 - 5) Mechanical Room HVAC and Plumbing Feeders.
 - 6) Ancillary Room Equipment Feeders.
 - 7) Generator Feeder.
 - 8) UPS Feeders.
 - 9) VFD Feeders.
 - 10) Photovoltaic System Feeders.
 - 11) Electric Vehicle Feeders.
3. Conditions of Test:
- a. Areas are complete and cleaned.
4. Acceptable Results:
- a. The Contractor shall test all electrical feeders and exterior branch circuits whose operating voltage is 600 volts or less that are installed under this contract and exterior branch circuits. The Testing and Commissioning Manager shall verify tests and submit a test report.
 - b. Test for continuity of each circuit.
 - c. Phase Relationship Tests: Check connections to all new and existing equipment for proper phase and phase rotation relationship. During check, disconnect all devices which could be damaged by the application of voltage or reversed phase sequence.

3.06 LEVEL 1 COMPONENT TESTS

- A. 2608-C-01: Instrument Transformers:
1. Systems/Equipment to be tested:
 - a. Current Transformers.
 - b. Potential Transformers.
 2. Functions to be tested:
 - a. Insulation resistance.
 - b. Ratio verification.
 - c. Polarity.
 - d. Transformer withdrawal mechanism.
 - e. Phase rotation.
 - f. Fuse sizes on primary and secondary on potential transformers.
 - g. Interlock function and contact operation.
 - h. Grounding and shorting connections.

- i. Secondary voltage.
 - j. Secondary wiring integrity.
3. Conditions of test – Current Transformers:
- a. Perform insulation resistance test of the current transformer and current transformer wiring to ground at 500 volts DC for 30 seconds. Disconnect ground connection at ground connection point in the circuit for this test. Do not perform on solid-state devices.
 - b. Perform a polarity test of each current transformer.
 - c. Perform a ratio verification test of each current transformer. This shall be performed using the voltage method or current method in accordance with IEEE C57.13.2.
 - d. Perform a DC dielectric withstand ability test on the primary windings with the secondary windings connected to ground.
4. Conditions of test – Potential Transformers:
- a. Perform insulation resistance tests on voltage transformers, winding-to-winding, and windings-to-ground.
 - b. Perform a polarity test on each transformer to verify the polarity marks or H1-X1 relationship. The test may be performed with a TTR type ratio set.
 - c. Perform a ratio test using a Transformer Turns Ratio (TTR) test set or by the voltage comparison method.
 - d. Perform a DC dielectric withstand ability test on the primary windings with the secondary windings connected to ground.
 - e. Verify secondary voltage by energized the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
 - f. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage.
5. Acceptable Results – Current Transformers:
- a. Insulation resistance test voltages and minimum resistances shall be in accordance with Exhibit A, Table 26 08 00 – A3, in this specification. Do not perform this test where solid state devices are utilized.
 - b. Polarity is verified correct.
 - c. Ratios are verified correct.
 - d. DC dielectric withstand ability is in accordance with Paragraph 8.8.2 and Tables 2 and 7 of ANSI/IEEE C57.13-1993 (Standard Requirements for Instrument Transformers).
6. Acceptable Results – Potential Transformers:

- a. Insulation resistance test voltages and minimum resistances shall be in accordance with Exhibit A, Table 26 08 00 – A3. Do not perform this test where solid state devices are utilized.
- b. Polarity is verified correct.
- c. Ratios are verified correct.
- d. DC dielectric withstand ability is in accordance with Paragraph 8.8.2 and Tables 2 and 7 of ANSI/IEEE C57.13-1993 (Standard Requirements for Instrument Transformers).
- e. Secondary voltage is verified correct.
- f. Proper potential at all devices.

B. 2608-C-02: Metering and Instrumentation:

- 1. Systems/Equipment to be tested:
 - a. Meters:
 - 1) Connection to Sound Transit, see Section 25 08 00 – Commissioning of Field Control System.
- 2. Functions to be tested:
 - a. Calibration at all cardinal points.
 - b. Instrument multipliers.
 - c. Tightness of electrical connections.
- 3. Conditions of test:
 - a. Verify accuracy of meters at all cardinal points
 - b. Verify all instrument multipliers.
 - c. Verify that current transformer and voltage transformer circuits are intact.
- 4. Acceptable Results:
 - a. Meter accuracy is verified correct.
 - b. Instrument multipliers are correct for application.

3.07 LEVEL 1 EQUIPMENT TESTS

A. 2608-E-01: Molded Case Circuit Breakers

- 1. System/Equipment to be tested:
 - a. Molded case circuit breakers serving switchboards, distribution panelboards, panelboards, central battery inverters, UPS, elevators, escalators, and mechanical equipment.
 - b. 3-phase molded case circuit breakers 60 amperes and greater.
- 2. Functions to be tested:

- a. Contact resistance.
- b. Insulation resistance.
- c. Verification of adjustments for final settings.
- d. Tightness of electrical connections.
- e. Performance characteristics of trip units based on coordination studies.

3. Conditions of the test:

- a. Perform a contact resistance test or millivolt drop across contacts at rated current.
- b. Perform an insulation resistance test from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase per Exhibit A, Table 26 08 00 – A3.
- c. Perform adjustments for final settings in accordance with Coordination Study supplied by Contractor.
- d. Perform primary current injection tests to ensure performance characteristics of trip units.
- e. Check trip unit reset operation.

4. Acceptable Results:

- a. Compare microhm or millivolt drop values to adjacent poles and similar breakers. Investigate, correct and re-test deviations of greater than 50 percent.
- b. Insulation resistance shall be per Exhibit A, Table 26 08 00 - A3
- c. All instantaneous trip times shall fall within manufacturer's time-current curves or use NEMA Standard AB4-1991 Table 5-3. Circuit breakers exceeding specified trip time at 300 percent of pickup shall be tagged defective.
- d. Trip unit setpoints match those listed in the final Short Circuit/Coordination/Arc Flash study report.

B. 2608-E-02: Medium Voltage Power Circuit Breakers

- 1. System/Equipment to be tested.
 - a. Medium voltage power circuit breakers.
- 2. Functions to be tested.
 - a. Test in compliance with the manufacturer's recommendation.
 - b. Test per Section 26 13 13 - Medium-Voltage AC Circuit Breaker Switchgear, Articles 2.11 and 2.13.
- 3. Acceptable results
 - a. Complies with manufacturer's recommendations.

- b. All results in accordance with IEEE C37.20.2, IEEE C37.09. and IEEE C57.13.
- C. 2608-E-03: Low Voltage Power Circuit Breakers
 - 1. System/Equipment to be tested.
 - a. Low voltage power circuit breakers serving switchboards, distribution panelboards, panelboards, central battery inverters, UPS, elevators, escalators, and mechanical equipment.
 - b. Low voltage power circuit breakers 60 amperes and greater.
 - 2. Functions to be tested:
 - a. Contact resistance.
 - b. Insulation resistance.
 - c. Verification of adjustments for final settings.
 - d. Tightness of electrical connections.
 - e. Long-time pickup and Long-time delay time-current characteristics.
 - f. Short-time pickup and delay.
 - g. Ground fault pickup and delay.
 - h. Operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
 - i. Trip unit reset operation based on coordination studies.
 - 3. Conditions of the test:
 - a. Perform a contact resistance test or millivolt drop across contacts at rated current.
 - b. Perform an insulation resistance test from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase per Exhibit A, Table 26 08 00 – A3.
 - c. Perform primary current injection tests to ensure performance characteristics of trip units.
 - d. Using the settings from the final Coordination Study, perform long-time pickup and long-time delay time-current characteristic tests by passing 300 percent rated current through each pole separately.
 - e. Using the settings from the final Coordination Study, determine short-time pickup and short-time delay by primary current injection.
 - f. Using the settings from the final Coordination Study, determine instantaneous pickup by primary current injection using run-up or pulse method.
 - g. Using the settings from the final Coordination Study, determine ground fault pickup and time delay by primary current injection.

- h. Verify the correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
- i. Check trip unit reset operation.
- j. Check key and other interlock safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including barriers and shutters.
- k. Test the correct operation of the electrical lockout feature on the tie breaker.

4. Acceptable Results:

- a. Compare microohm or millivolt drop values to adjacent poles and similar breakers. Investigate, correct and re-test deviations of greater than 50 percent.
- b. Insulation resistance values shall be per Exhibit A, Table 26 08 00 - A3
- c. Instantaneous pickup value shall be per NEMA Publication AB4-1991, Table 5-4.
- d. Trip characteristics of breakers shall fall within manufacturer's published time current tolerance band including all adjustment factors.
- e. Trip unit setpoints match those listed in the final Short Circuit/Coordination/Arc Flash study report.

D. 2608-E-04: Ground Fault Protection System

- 1. System/Equipment to be tested:
 - a. Ground Fault Protection System.
- 2. Functions to be tested:
 - a. Adjustable trip and time delay functions.
 - b. Trip unit reset operation.
 - c. Circuit interrupting device.
 - d. Relay pickup current.
 - e. Relay time delay.
 - f. Ground monitor panel where applicable.
 - g. Sensor polarity on phase and neutral sensors.
 - h. Indicator lights and flags.
- 3. Conditions of test:
 - a. Set the adjustable trip and time delay functions based on the data generated from the ground fault system study.
 - b. Verify trip unit reset operation.

- c. Test correct response of the circuit interrupting device by using ground sensor current injection to measure Relay pickup current.
- d. Test correct response of the circuit interrupting device by using ground sensor current injection to measure Relay Time Delay. (Measure at two values above pickup current).
- e. Verify proper sensor polarity on phase and neutral sensors.
- f. Functionally check operation of ground fault indicator lights and flags for correct indication of ground fault trip.

4. Acceptable Results:

- a. Trip unit resets properly.
- b. Adjustable trip and time delay functions correspond to settings generated in the ground fault system study.
- c. Circuit interrupting device operates properly.
- d. Ground fault indicator lights and flags operate properly.
- e. Trip unit setpoints match those listed in the final Short Circuit/Coordination/Arc Flash study report.

E. 2608-E-05: Dry Type Medium Voltage Transformers

1. Systems/Equipment to be tested:

- a. Dry type transformers.

2. Functions to be tested:

- a. Insulation resistance.
- b. Reference: Low voltage transformers requirements as stated in the Contract Documents.

3. Conditions of test:

- a. Perform insulation resistance test. Measurements shall be made from winding-to-winding and winding-to-ground.

4. Acceptable Results:

- a. Test voltages and minimum resistances shall be in accordance with Exhibit A Table 26 08 00 - A1. Results to be temperature corrected in accordance with Exhibit A Table 26 08 00 - A4.
- b. Verify and record taps and connect transformer to desired tap.
- c. Verify correct phase rotation.

F. 2608-E-06: Switchboards

1. System/Equipment to be tested:

- a. Switchboards.
- b. Distribution Panelboards.

- c. Branch Circuit Panelboards.
- 2. Functions to be tested:
 - a. Insulation resistance.
 - b. Phase rotation.
 - c. Reference: Switchboard requirements as stated in the Contract Documents.
- 3. Conditions of test:
 - a. Perform insulation resistance test phase-to-phase and phase-to-ground of each bus section.
- 4. Acceptable Results:
 - a. Insulation resistance test voltages and minimum resistances shall be in accordance with Exhibit A, Table 26 08 00 - A3.
 - b. Phase rotation shall be compatible with the serving utility.
- G. 2608-E-07: Motor Control Equipment:
 - 1. Systems/Equipment to be tested:
 - a. Motor starters.
 - b. Enclosed motor controllers (general purpose, across-the-line starters).
 - c. Variable Frequency Drives.
 - 2. Functions to be tested (All motor control equipment):
 - a. Insulation resistance.
 - b. Overload unit operation with setpoint per service factor, FLA and NEC Article 430.
 - c. Control devices.
 - d. Phase rotation.
 - 3. Additional Functions to be tested (Variable Frequency Drives):
 - a. Check motor rotation when operating on the drive and the bypass.
 - b. Verify Critical frequencies to be avoided (jumped) during operation by varying speed from minimum to maximum and observing motor for unusual vibration and noise.
 - c. Operate from remote start-stop and speed control signals.
 - 4. Conditions of test:
 - a. Measure insulation resistance of each starter phase-to-phase and phase-to-ground with the starter contacts closed and the protective device open.
 - b. Measure insulation resistance of each control circuit with respect to ground.

- c. Verify and confirm the motor requirement specified in Division 22 and Division 23 Commissioning specification.
- d. Test motor overload units (except solid-state type) by injecting primary current through overload unit and monitoring trip time at 300 percent of motor full load current.
- e. Perform operational tests by initiating control devices to affect proper operation.
- f. Verify installation in accordance with manufacturer's instructions and in accordance with visual and mechanical inspection requirements.
- g. VFD programmable parameter settings established.
- h. VFD jump frequency settings coordinated.
- i. VFD power failure recovery restart settings coordinated.

5. Acceptable Results:

- a. Insulation resistance test voltages and minimum resistances shall be in accordance with manufacturer's published data. Manufacturer shall be consulted for test voltage where solid state devices are utilized.
- b. Overload tests shall be in accordance with manufacturer's tolerances. Investigate values more than 120 seconds.
- c. Phase rotation shall be compatible with the serving utility.
- d. Installation in compliance with manufacturer's procedures and criteria.
- e. VFD parameter settings reviewed and signed off by HVAC and electrical contractors. Record all settings for use by Sound Transit.
- f. VFD jump settings reviewed and signed off by HVAC and electrical contractors. Record all settings for use by Sound Transit.
- g. VFD power failure recovery restart settings reviewed and signed off by HVAC and electrical contractors. Record all settings for use by Sound Transit.
- h. Following successful completion of testing specified for Soft Start motors outlined in commissioning of HVAC systems as stated in the Contract Documents, record all settings for use by Sound Transit.

H. 2608-E-08: Receptacles:

- 1. Equipment to be tested:
 - a. Receptacles standard.
 - b. Receptacles Ground Fault Circuit Interrupter (GFCI).
- 2. Functions to be tested:
 - a. Open ground.
 - b. Reverse polarity.

- c. Open hot.
 - d. Open neutral.
 - e. Hot and ground reversed.
 - f. Ground Fault Receptacle Circuit Interrupter when so equipped.
 - 3. Conditions of the test:
 - a. Perform all tests with adjustable GFCI and circuit tester.
 - b. GFCI TEST button on receptacle not acceptable for test.
 - 4. Acceptable Results:
 - a. Tester indicates correct wiring.
 - b. GFCI trips on ground fault current 5 milliamperes or greater.
 - c. GFCI does not trip on ground fault current less than 5 milliamperes.
- I. 2608-E-09: Interior Lighting Control Devices
- 1. Systems/Equipment to be tested for both normal and emergency circuits in interior application:
 - a. Manual Light Switch:
 - 1) 3-way Light Switch.
 - b. Occupancy Sensors (ceiling or wall mount).
 - c. Vacancy Sensors (ceiling or wall mount).
 - d. Daylighting Sensors (integral or external to the light fixture).
 - e. Motion Sensors (integral or external to the light fixture).
 - 2. Functions to be tested:
 - a. Manually turns light on and off:
 - 1) 3-way light switch manually turns light on and off.
 - b. Automatic control of lighting fixtures.
 - c. Manual override of automatic function.
 - 3. Conditions of the test:
 - a. Verify all settings of the sensors match the controls sequence of operation and record all settings.
 - b. For manual light switch:
 - 1) Manually turns lights on when manual light switch toggle to ON position.
 - 2) Manually turns lights off when manual light switch toggle to OFF position.

- 3) For 3-way light switches, manually turns lights on when one of the manual light switch toggles to ON position. Then manually turns lights off when the other manual light switch toggles to OFF position. Then reverse the test from one manual light switch to another manual light switch.
- c. For occupancy sensor:
 - 1) After device has timed out, walk into the space to verify initial response to sensing occupancy.
 - 2) Leave space to verify response to the unit not sensing occupancy for a certain amount of time that lights turn off.
- d. For vacancy sensor:
 - 1) Manually turns lights on.
 - 2) Leave space to verify response to the unit not sensing occupancy for a certain amount of time that lights turn off.
- e. Operate light switches to verify response.
- f. For Daylighting Sensor:
 - 1) Check placement of the daylight sensor.
 - 2) Testing must be done during the daytime and nighttime.
 - a) Daytime test, test the dimming ability of the sensor when outside daylight shines upon the room.
 - b) Nighttime test, test the brightening ability of the sensor when there is no outside daylight available.
 - 3) Test with varying amount of light into the daylighting zones.
 - 4) Test the footcandle minimum illumination of the fixtures at maximum dimming when there is no sunlight coming into the daylighting zones.
 - 5) When necessary, relocated and calibrated the sensor to track interior daylight levels.
- g. Motion sensors:
 - 1) Test the function of the motion sensor switching capability for lights to dim when sensor do not detect any movement.
 - 2) Test the function of the motion sensor when sensor detects movement, light turns back to 100 percent.
4. Acceptable Results:
 - a. For manual light switch, turn lights on when light switch toggles to ON position and turn lights off when light switch toggles to OFF position.
 - 1) Similar concept in 3-way manual light switches.
 - b. Occupancy Sensor:

- 1) Occupancy sensors turn on selected light fixtures upon first entering the room.
- 2) Initially the occupancy sensor will turn off the light fixtures but will automatically turn the light fixtures back on after occupancy sensor detects movement.
- 3) Occupancy sensor turns lights off per setting specified in the control sequence of operation.
- 4) Upon the sensor not sensing occupancy for the timed delay duration, the device automatically turns off the room light fixtures.
- 5) The sensor is not affected by HVAC noise or heat or other external factors that would prevent the fixtures from turning off automatically when there is no occupancy for the set time-out duration.

c. Vacancy Sensor:

- 1) Vacancy sensors require that the occupant manually turn on the light switch when first entering the room.
- 2) Prior to the sensor timing out, the light switch can be turned to the OFF position to turn the lights off within the room and the lights will remain off when the occupant enters the room.
- 3) Vacancy sensor turns light off per setting specified in the control sequence of operation.

d. Daylighting Sensor:

- 1) All required fixtures within the daylighting zones dim with more sunlight into the zone.
- 2) All required fixtures within the daylighting zone brighten as sunlight into the zone diminishes.
- 3) The primary zone fixtures dim first and reach minimum lighting levels prior to the secondary zone fixtures dimming and reaching their minimum lighting levels.
- 4) The space lighting levels do not dim to less than the design required minimum footcandle levels within the daylighting zones.

e. Motion Sensor:

- 1) Lights automatically reduced when there is no activity detected within the lighting zone.
- 2) Lights automatically turns back to 100 percent when there is activity detected within the lighting zone.
- 3) Dimming percent and time for no detection based on the control sequence of operation.

J. 2608-E-10: Exterior Lighting Control Devices

1. Systems/Equipment to be tested for exterior application for normal and emergency lighting:

- a. Motion Sensor (integral or external to the light fixture).
 - b. Photocell.
 - c. Lighting control time clocks (relay control panels).
 - d. Manual override-on.
2. Functions to be tested:
- a. Automatic control of lighting loads.
 - b. Manual override on
 - c. Relay status
 - d. Schedule modifications
 - e. Network Interface
3. Conditions of the test:
- a. Verify all settings of the sensors match the controls sequence of operation and record all settings.
 - b. Motion Sensor:
 - 1) Test the function of the motion sensor switching capability for lights to dim when sensor do not detect any movement.
 - 2) Test the function of the motion sensor when sensor detects movement, light turns back to 100 percent.
 - c. Lighting control time clocks (relay control panels)
 - 1) Test the function of the time clock.
 - d. Photocell:
 - 1) Photocell must be clean and free of debris.
 - 2) Test the function of the sensor switching capability for lights off during daytime and lights on during the nighttime or dust-to-dawn.
 - e. Manual override-on:
 - 1) Manual override-on is a temporary control for lights to be turn on.
 - 2) Test the function of the manual override-on switching capability to turn on all exterior lights.
 - 3) Exterior lights must be on for four or six hours once the manual override-on activated.
 - 4) Once the four or six hours ends, the lighting control panel take over the control sequence.
4. Acceptable Results:
- a. Motion Sensor:

- 1) Lights automatically reduced when there is no activity detected within the lighting zone.
 - 2) Lights automatically turns back to 100 percent when there is activity detected within the lighting zone.
 - 3) Dimming percent (%) and time for no detection based on the control sequence of operation.
- b. Photocell:
- 1) All required lights turn off during daytime and lights turns on during nighttime or dusk-to-dawn function.
- c. Lighting Control time clocks (relay controls).
- 1) Demonstrate automatic control via controller CPU to schedule the exterior fixtures and lighting circuits on and off based on a built-in astronomical clock schedule.
 - 2) Manually override all automatic functions to control lights regardless of time-of-day schedule or daylight control requirement.
 - 3) Verify relay status.
 - 4) Demonstrate time control and the ability to modify schedules.
 - 5) Demonstrate override control of the light control system via the network lighting controller.
- d. Lighting control time clock.
- 1) All exterior lights turn on to the specified time.
 - 2) All exterior lights turn off to the specified time.
- e. Manual override-on
- 1) All exterior lights turn on for four or six hours.
 - 2) Lighting control panel take over the control sequence.

K. 2608-E-11: Egress Fixtures and Exit Signs

1. Systems/Equipment to be tested:
 - a. Egress fixtures and exit signs.
2. Functions to be tested:
 - a. Operation under facility normal electrical power service
 - b. Operation under facility emergency electrical power service via central battery inverter.
3. Conditions of the test:
 - a. Verify location of egress fixtures and exit signs match the Contract Document.

- b. Facility is served by normal electrical power source.
- c. Simulate loss of facility normal electrical power source by switching off main normal power to the building at the main entrance switchgear.
- d. Exit signs do not turn off between simulation of normal and emergency electrical powers.
- e. Exit sign do not turn off during daytime.

4. Acceptable Results:

- a. Under normal power, egress fixtures are controlled by the lighting control systems per their normal sequence of operation and turn off and dim accordingly per the lighting low voltage relay panel schedules, occupancy sensors, and daylighting controls.
- b. Exit signs always remain on.
- c. After a power loss, all egress fixtures and exit signs re-illuminate fully within 10 seconds of the start of the power loss event and remain on for a minimum of 90 minutes.
- d. All egress fixtures and exit signs return to normal operation when normal power service is restored to the facility and central battery inverter starts recharging.

L. 2608-E-12: Transfer Switches

1. System/Equipment to be tested.

- a. Transfer Switch

2. Functions to be tested:

- a. Load transfer to alternate standby power (mobile generator).
- b. Load transfer to normal utility power.
- c. Verification of adjustments for final settings.
- d. Tightness of electrical connections.

3. Conditions of the test:

- a. Facility is served by normal utility power source.
- b. Simulate loss of facility normal utility power source by switching off main normal power to the building at the service entrance. Simulate outage with emergency and communication systems running on battery backup.
- c. Do not manually operate the transfer switch until both power sources are disconnected: open both normal and standby source circuit breakers.
- d. Use the maintenance handle to manually operate transfer switch. Comply with manufacturer's "Manual Operations Test" procedures and instruction requirements.
- e. Review manufacturer's control features operation prior to activation on switch control sequence

4. Acceptable Results:
 - a. The transfer switch does not retransfer the electrical load automatically.
 - b. The mobile generator is not stopped automatically.
 - c. Documentation of testing procedures, adjustments/settings, and results in compliance with NFPA 110 acceptance testing and manufacturer's testing instructions.
 - d. Documentation of verification and confirmation of transfer switch and mobile generator compatibility.
 - e. Loads run normally when generator power is connected and after transfer back to normal power.
 - f. No damage to equipment

M. 2608-E-13: Generator Receptacle

1. System / Equipment to be tested:
 - a. Enclosed Generator Receptacle
2. Functions to be tested:
 - a. Open ground
 - b. Phasing
 - c. Open hot
 - d. Open neutral
 - e. Hot and ground reversed.
3. Conditions of the test:
 - a. Perform all tests and document the results for the functional test
4. Acceptable Results:
 - a. Tester indicates correct wiring.

N. 2608-E-14: Safety Switched and Enclosed Circuit Breakers

1. System/Equipment to be tested.
 - a. Fused Disconnect
 - b. Enclosed Circuit Breaker
2. Functions to be tested:
 - a. Contact resistance.
 - b. Insulation resistance.
 - c. Verification of adjustments for final settings.
 - d. Tightness of electrical connections.

- e. Long-time pickup and Long-time delay time-current characteristics.
 - f. Short-time pickup and delay.
 - g. Ground fault pickup and delay.
 - h. Operation of any auxiliary features such as trip and pickup indicators, electrical close and trip operation, and trip-free.
 - i. Trip unit reset operation based on coordination studies.
3. Conditions of the test:
- a. Perform a contact resistance test or millivolt drop across contacts at rated current.
 - b. Perform an insulation resistance test from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase per Exhibit A, Table 26 08 00 – A3.
 - c. Perform primary current injection tests to ensure performance characteristics of trip units.
 - d. Using the settings from the final Coordination Study, perform long-time pickup and long-time delay time-current characteristic tests by passing 300 percent rated current through each pole separately.
 - e. Using the settings from the final Coordination Study, determine short-time pickup and short-time delay by primary current injection.
 - f. Using the settings from the final Coordination Study, determine instantaneous pickup by primary current injection using run-up or pulse method.
 - g. Using the settings from the final Coordination Study, determine ground fault pickup and time delay by primary current injection.
 - h. Verify the correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
 - i. Check trip unit reset operation.
 - j. Check key and other interlock safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including barriers and shutters.
 - k. Test the correct operation of the electrical lockout feature on the tie breaker.
 - l. Test fuse clips and ON/OFF handle.
4. Acceptable Results:
- a. Compare microohm or millivolt drop values to adjacent poles and similar breakers. Investigate, correct and re-test deviations of greater than 50 percent.
 - b. Insulation resistance values shall be per Exhibit A, Table 26 08 00 - A3

- c. Instantaneous pickup value shall be per NEMA Publication AB4-1991, Table 5-4.
- d. Trip characteristics of breakers shall fall within manufacturer's published time current tolerance band including all adjustment factors.
- e. Trip unit setpoints match those listed in the final Short Circuit/Coordination/Arc Flash study report.

3.08 LEVEL 1 SYSTEM TESTS

A. As described under the Systems Contract.

B. 2608-S-01 Standby Generator Functional Test:

1. Systems/Equipment to be tested:
 - a. Generator.
 - b. Automatic Transfer Switches.
 - c. Interface to BMS.
 - d. Interface to Fire Alarm.
 - e. Interface to elevator(s) and Elevator Machine Room(s)
 - f. Facility Equipment Under Emergency Power and Transition Conditions.
2. Functions to be tested:
 - a. Generator on-board controls and interfaces to electrical system via transfer switch.
 - b. Automatic transfer switch operation and interfaces to electrical system switchboards and panelboards.
 - c. Interfaces of generator and ATS to BMS.
 - d. Interfaces of generator and ATS to fire alarm.
 - e. Interfaces of generator to elevator(s) and Elevator Machine Rooms(s).
3. Conditions of the test:
 - a. Generator:
 - 1) Test all components, equipment, and integral on-board controls of the generator, including all component, equipment, and system operating observations and modes of operation, per the manufacturer's recommended methods and as applicable for field observations and testing.
 - b. Automatic Transfer Switch:
 - 1) Test all components, equipment, and integral on-board controls of the automatic transfer switch, including all component, equipment, and system operating observations and modes of operation, per the manufacturer's recommended methods and as applicable for field observations and testing.

- 2) Test interfaces to generator for signaling of standard interface and coordination points including call for generator start, normal and alternate power source availability, automatic and manual posturing controls and operations, generator cooldown, phase synchronization transfer controls, etc.
 - 3) Test that phase rotation from generator to ATS matches the normal utility service source phase rotation.
- c. Interface to BMS:
- 1) Test all monitored points between the generator and ATS.
- d. Interfaces to Fire Alarm System:
- 1) Test all monitored points between the generator and ATS.
- e. Interface to Elevator(s) and Elevator Machine Room(s):
- 1) Test for Concurrent Maximum Load Measurement.
 - a) Load elevator up with as many people as possible and travel from lowest floor stop to highest floor stop.
 - b) Alternatively, the L&I elevator testing may have recorded the maximum amp loading for the elevator equipment when the elevator max load testing was conducted. Use that data, if available.
 - 2) Test all elevator equipment, controls and 120V distribution panel inside the Elevator Machine Room(s).
- f. Building Blackout and Recovery Test:
- 1) Coordinate with all affected subcontractors and lead a building blackout and recovery test for the facility.
 - a) This test shall be conducted when the affected equipment and systems have been substantially commissioned so that their operation under normal power, loss of normal power, transition and running under emergency power, and transition and running back to normal power can be verified.
 - b) Conduct this test with all subcontractors observing their respective equipment and systems during this test.
 - 2) Open the normal electrical utility service breaker to simulate a normal power loss condition for the facility.
 - 3) Verify the emergency electrical service timing for emergency lighting to ensure that it is restored within 10 seconds of normal service loss.
 - 4) Wait for the others to observe the reaction of their equipment and systems under loss of power conditions and as the systems transition and run under the generator (observations include the emergency central battery inverters (or UPS)). Then, after all observations are complete, close the breaker for normal electrical power service.

- 5) Wait for the others to observe the reaction of their equipment and systems under transfer back from emergency to normal source. If the observed equipment and systems do not operate per design and per the manufacturer's documentation, conduct the test again until all observed equipment and systems operate correctly.
4. Acceptance Criteria:
- a. Generator:
 - 1) Verify all components, equipment, and integral on-board controls of the generator, including all component, equipment, and system operating observations and modes of operation, operate per the design requirements and the manufacturer's operation manuals.
 - b. Automatic Transfer Switch:
 - 1) Verify all components, equipment, and integral on-board controls of the generator, including all component, equipment, and system operating observations, and modes of operation, operate per the design requirements and the manufacturer's operation manuals.
 - 2) Verify that all control and monitoring points between the generator and automatic transfer switch work correctly to provide a fully operational system.
 - 3) Verify that the phase rotation from generator matches the normal utility service source phase rotation where they both input to the ATS.
 - c. Interfaces to BMS:
 - 1) Verify all monitored points between the generator and ATS and the BMS.
 - d. Interfaces to Fire Alarm System:
 - 1) Verify all monitored points between the generator and ATS and the fire alarm system.
 - e. Interfaces to elevator(s) and Elevator Machine Room(s):
 - 1) Verify elevator(s) works under generator power and operates with Maximum Load from lowest floor stop to highest floor stop.
 - 2) Verify all elevator equipment, controls and 120V panel works under generator power inside the Elevator Machine Room(s).
 - f. Building Blackout and Recovery Test:
 - 1) The generator and automatic transfer switch operate correctly to provide normal utility electrical service to the facility when it is available and to automatically switch service to facility emergency power distribution loads when normal utility electrical service is lost.
 - 2) The emergency life safety circuits and equipment return to operation, under emergency power, within 10 seconds of power loss (note that these functions are energized at least initially via the central battery inverter (or UPS).

- 3) The equipment that is not served by emergency power circuits immediately stops and does not come back on under generator operation.
- 4) The equipment that is served by emergency power circuits may initially stop but come back on after generator power is supplied to those circuits and that they automatically restart with no nuisance alarms or the requirement for operator interventions to restart them.
- 5) When the utility service is restored, the transfer switch automatically transfers once again provide normal utility power service to the building and the generator cools down and stops automatically.
- 6) When the transition back to normal occurs, the equipment served by emergency power circuits remain operational, without nuisance alarms or failures due to the transition.
- 7) When normal power service is restored, the equipment and systems not served by emergency circuits automatically restart with no nuisance alarms or the requirement for operator interventions to restart them.

C. 2608-S-02 Portable Generator Functional Test – Stations

1. System / Equipment to be tested:
 - a. Operation of system on portable generator.
 - b. Interface to elevator(s) and Elevator Machine Room(s)
2. Functions to be tested:
 - a. Connection of portable generator to generator receptacle.
 - b. Startup of generator and transfer of Station loads via Manual Transfer Switch.
 - c. Operation of Station loads while running on generator power. Run Station loads for a minimum of 30 minutes.
 - d. Transfer of Station loads back to normal power via the Manual Transfer Switch.
 - e. Interfaces of generator to elevator(s) and Elevator Machine Rooms(s).
3. Conditions of the Test:
 - a. Station under a simulated outage with emergency and communication systems running on battery backup.
 - b. Contractor to provide a 200 kVA, 480 V, 3 phase, 4 wire portable generator with the matching connection to the 200A generator receptacle installed on site for the purposes of completing portable generator and manual transfer switch commissioning activities. Sound Transit owned portable generators may be used instead of contractor provided generator only if available. Coordinate use of Sound Transit owned portable generator with Resident Engineer.

- c. Measure generator receptacle phasing in the field and configure generator to match so that no phase shifting occurs when loads are transferred to the generator. Provide documentation of the phasing to the Resident Engineer.
- d. Measure generator receptacle phasing in the field and verify the phases match the installation documentation, revise phases if required to match documented phases so the same generator can back up the station without requiring any modifications. Configure generator to match so that no phase shifting occurs when loads are transferred to the generator. Provide documentation of the phasing from the Station and provide to the Resident Engineer.
- e. Interface to Elevator(s) and Elevator Machine Room(s):
 - 1) Test for Concurrent Maximum Load Measurement.
 - a) Load elevator up with as many people as possible and travel from lowest floor stop to highest floor stop.
 - b) Alternatively, the L&I elevator testing may have recorded the maximum amp loading for the elevator equipment when the elevator max load testing was conducted. Use that data, if available.
 - 2) Test all elevator equipment, controls and 120V distribution panel inside the Elevator Machine Room(s).

4. Acceptable Results:

- a. Loads run normally when generator power is connected and after transfer back to normal power.
- b. No damage to equipment
- c. Verify that the Stations' generator receptacle phasing matches the Garage generator receptacle phasing and adjust wiring for the Garage so that the single generator provided for testing can plug into either receptacle or transfer the loads without causing a phase shift in either location.
- d. Interfaces to elevator(s) and Elevator Machine Room(s):
 - 1) Verify elevator(s) works under generator power and operates with Maximum Load from lowest floor stop to highest floor stop.
 - 2) Verify all elevator equipment, controls and 120V panel works under generator power inside the Elevator Machine Room(s).

D. 2608-S-03 Portable Generator Functional Test – Garages:

- 1. System / Equipment to be tested:
 - a. Operation of system on portable generator.
 - b. Interface to elevator(s) and Elevator Machine Room(s)
- 2. Functions to be tested:
 - a. Connection of portable generator to generator receptacle.

- b. Startup of generator and transfer of Garage loads via Manual Transfer Switch.
 - c. Operation of Garage loads while running on generator power. Run Garage loads for a minimum of 30 minutes.
 - d. Transfer of Garage loads back to normal power via the Manual Transfer Switch.
 - e. Interfaces of generator to elevator(s) and Elevator Machine Rooms(s).
3. Conditions of the Test:
- a. Garage under a simulated outage with emergency and communication systems running on battery backup.
 - b. Contractor to provide a 3 phase, 4 wire portable generator with the matching connection to the generator receptacle installed on site.
 - c. Measure generator receptacle phasing in the field and configure generator to match so that no phase shifting occurs when loads are transferred to the generator. Provide documentation of the phasing to the Resident Engineer.
 - d. Measure generator receptacle phasing in the field and verify the phases match the installation documentation from the contract, revise phases if required to match documented phases so the same generator can backup other Sound Transit locations without requiring any modifications. Configure generator to match so that no phase shifting occurs when loads are transferred to the generator. Provide documentation of the phasing to the Resident Engineer.
 - e. Interface to Elevator(s) and Elevator Machine Room(s):
 - 1) Test for Concurrent Maximum Load Measurement.
 - a) Load elevator up with as many people as possible and travel from lowest floor stop to highest floor stop.
 - b) Alternatively, the L&I elevator testing may have recorded the maximum amp loading for the elevator equipment when the elevator max load testing was conducted. Use that data, if available.
 - 2) Test all elevator equipment, controls and 120V distribution panel inside the Elevator Machine Room(s).
4. Acceptable Results:
- a. Loads run normally when generator power is connected and after transfer back to normal power.
 - b. No damage to equipment.
 - c. Interfaces to elevator(s) and Elevator Machine Room(s):
 - 1) Verify elevator(s) works under generator power and operates with Maximum Load from lowest floor stop to highest floor stop.

- 2) Verify all elevator equipment, controls and 120V panel works under generator power inside the Elevator Machine Room(s).

E. 2608-S-04: Central Battery Inverter and Uninterruptible Power Supply:

1. System/Equipment to be tested:
 - a. Central Battery Inverter.
 - b. Uninterruptible Power Supply.
2. Functions to be tested:
 - a. Normal and bypass operation including bypass function.
 - b. Local alarms.
 - c. Remote communications.
 - d. Battery supply.
 - e. Output voltage (by vendor).
 - f. Battery monitoring (by vendor).
 - g. Connection torque (by vendor).
3. Conditions of test:
 - a. Test the normal and bypass operation of the inverter/UPS using resistive load banks to simulate all types of load conditions.
 - b. Test protective and alarm functions.
 - c. Test monitoring capabilities locally and remotely.
 - d. Perform a 15-minute battery rundown test.
 - e. Provide documentation that overload capacity testing was performed by manufacturer.
 - f. Install power recording meters to record all unit parameters under actual load conditions. Meters to be installed at inverter/UPS and at panelboard served.
4. Acceptable Results:
 - a. Normal and bypass operation of inverter/UPS meets design criteria as stated in the Contract Documents. Provide record of input and output voltage and current at 25 percent, 50 percent, 75 percent and 100 percent load.
 - b. Remote monitoring location receives correct information regarding Unit Status, Unit Parameters and Unit Alarms.
 - c. Batteries are able to provide 15 minutes supply to loads with 75 minutes of capacity remaining under simulated full load when the inverter/UPS is disconnected from its power source.

- d. Overload capacity meets design criteria as shown in manufacturer's test report. 125 percent for 10 minutes, 150 percent for 30 seconds.
- F. 2608-S-05: Lighting Control Panels:
 - 1. Systems/Equipment to be tested for both normal and emergency circuits in interior and exterior application:
 - a. Lighting Control Panels.
 - 1) Override Manual Switch (see settings in lighting control sequence of operation).
 - 2. Functions to be tested:
 - a. Lighting Control Panels:
 - 1) Automatic control of lighting loads.
 - 2) Manual override of automatic function.
 - 3) Relay status.
 - 4) Power failure and subsequent Power Up.
 - 5) Daylight control settings.
 - 6) Time control settings.
 - 7) Network Interface.
 - 3. Conditions of the test:
 - a. Lighting Control Panel:
 - 1) Demonstrate automatic control via controller CPU.
 - 2) Manually override all automatic functions to control lights regardless of time-of-day schedule or daylight control requirement.
 - 3) Verify relay status.
 - 4) Fail the incoming power to the controller for a period of 30 minutes. Failure of power to take place 10 minutes prior to a programmed change in the lighting control schedule. Restore power to the controller to verify time scheduled events that were to take place during the power outage will be automatically activated.
 - 5) Demonstrate daylight control by inhibiting the amount of light to the sensor.
 - 6) Demonstrate time control and the ability to modify schedules.
 - 7) Demonstrate override control of the light control system via the network lighting controller.
 - 4. Acceptable Results:
 - a. Lighting Control Panel:

- 1) Automatic control satisfactorily operates per programmed schedules.
- 2) Manual override bypasses normal controller operation and turns on all lights.
- 3) Relay status feedback monitors actual status of each relay.
- 4) The controller activates in the correct operating status following failure of power.
- 5) Daylight sensor shall respond to diminished lighting. Measure light levels before and after inhibiting sensor.
- 6) Lighting controller operates satisfactorily following modification of time schedules.
- 7) Network lighting controller provides complete override control over the lighting system.

G. 2608-S-06: Photovoltaic Collectors:

1. System/Equipment to be tested:
 - a. Micro-Inverters.
 - b. Photovoltaic Modules.
 - c. AC & DC Overcurrent Protection Devices.
 - d. Photovoltaic Collectors Power Distribution.
2. Functions to be tested:
 - a. Insulation resistance.
 - b. Tightness of electrical connections.
 - c. Circuit breaker functions, as applicable.
3. Conditions of the test:
 - a. Perform a contact resistance test or millivolt drop across contacts at rated current.
 - b. Peak and lowest solar exposure.
 - c. Conditions for circuit breakers, as applicable
4. Acceptable Results:
 - a. Photovoltaic metering equipment provides metering of instantaneous and continuous KW and kWh output.
 - b. When applicable, check the cellular connectivity to remote monitoring system.

3.09 LEVEL 2 SYSTEM TESTING REQUIREMENTS

- A. Systems checklists are required to include the following, at a minimum:

B. 2608-IS-01: Lighting System BMS Interface:

1. Systems to be tested:
 - a. Networked Lighting Systems.
2. Systems functions to be tested:
 - a. Hours of Operation.
 - b. Override On.
 - c. Trouble.
3. Conditions of the test: Refer to the control diagrams and Division 25 specifications for points lists.
 - a. Acceptance Criteria: All functions and communications indicated in the sequence of operation and points lists transmit correctly. For equipment provided with emergency electrical power service, the BMS interfaces and fan equipment automatically restart after power is transferred to an emergency power source without nuisance alarms or the need for operator intervention. When normal power is restored and power is transferred back to the normal power source, the BMS interfaces and fan equipment continue to operate without nuisance alarms or the need for operator intervention.

C. 2608-IS-02: Uninterruptible Power Supplies BMS Interface:

1. Systems to be tested:
 - a. Uninterruptible Power Supply Systems.
2. Systems functions to be tested:
 - a. Battery failure.
 - b. Power failure.
 - c. UPS on battery.
3. Conditions of the test: Refer to the control diagrams and Division 25 specifications for points lists.
4. Acceptance Criteria: All functions and communications indicated in the sequence of operation and points lists transmit correctly. For equipment provided with emergency electrical power service, the BMS interfaces and fan equipment automatically restart after power is transferred to an emergency power source without nuisance alarms or the need for operator intervention. When normal power is restored and power is transferred back to the normal power source, the BMS interfaces and fan equipment continue to operate without nuisance alarms or the need for operator intervention.

3.10 LEVEL 1 AND LEVEL 2 TEST REQUIREMENTS MATRIX

	2608-IV-0X	2608-ST-0X	2608-C-0X	2608-E-0X	2608-S-0X	2608-IS-0X
Power wires, conductors, and cables	X					
Grounding and bonding for electrical systems	X					
Transformers	X					
Medium voltage metal clad switchgear	X					
Switchboards	X					
Panelboards	X					
Circuit breakers	X					
Motor control centers	X					
Motor Control Equipment (FVNR, Soft-Start and VFD)	X					
Protective Device Relays	X					
Instrument Transformers	X					
Metering and Instrumentation	X					
Central Battery Inverter	X					
Batteries	X					
Static uninterruptible power supply	X					
Lighting Systems	X					
Photovoltaic Collectors	X					
Electric Vehicle charging systems	X					
Transfer Switches	X					
Enclosed Switches, Fuses and Disconnects	X					
Generators	X					
Insulation Resistance		X				
Bolted Connection Torque		X				
Ground Resistance		X				
Lighting Systems Illuminance Levels		X				
Circuit Continuity and Phase Relationship		X				
Instrument Transformers			X			
Metering and Instrumentation			X			
Molded Case Circuit Breakers				X		
Medium Voltage Power Circuit Breakers				X		
Low Voltage Power Circuit Breakers				X		
Ground Fault Protection System				X		
Dry Type Medium Transformers				X		
Switchboards				X		
Motor Control Equipment				X		
Receptacle				X		

	2608-IV-0X	2608-ST-0X	2608-C-0X	2608-E-0X	2608-S-0X	2608-IS-0X
Interior Lighting Control Devices				X		
Exterior Lighting Control Devices				X		
Egress Fixtures and Exit Signs				X		
Transfer Switches				X		
Generator Receptacle				X		
Safety Switched and Enclosed Circuit Breakers				X		
Generator Functional Test					X	
Portable Generator Functional Test – Stations					X	
Portable Generator Functional Test - Garage					X	
Central Battery Inverter and Uninterruptible Power Supply					X	
Lighting Control Panels					X	
Photovoltaic Collectors					X	
Lighting System BMS Interface						X
Uninterruptible Power Supplies BMS Interface						X

3.11 LEVEL 3 INTER-STATION SYSTEM INTERFACE TEST REQUIREMENTS

- A. Support Level 3 tests in accordance with general commissioning requirements as stated in the Contract Documents.

END OF SECTION

EXHIBITS (On Proceeding Pages)

1. **Exhibit A:** Test Parameter Tables
2. **Exhibit B:** Example Installation Verification Form
3. **Exhibit C:** Example Equipment Test

EXHIBIT A - TABLE SECTION 26 08 00 – A1**TRANSFORMER INSULATION-RESISTANCE****ACCEPTANCE TEST VOLTAGE AND MINIMUM RESULTS**

Transformer Coil Rating Type in Volts	Minimum dc Test Voltage	Recommended Minimum Insulation Resistance in Megohms	
		Liquid Filled	Dry
0 - 600	1000	100	500
601 - 5000	2500	1000	5000
5001 – 15000	5000	5000	25000

TABLE 26 08 00 – A2**US STANDARD BOLT TORQUES FOR BUS CONNECTIONS****HEAT-TREATED STEEL - CADMIUM OR ZINC PLATED**

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches	Torque (Foot Pounds)			
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

BOLT TORQUES FOR BUS CONNECTIONS**SILICON BRONZE FASTENERS ¹****TORQUE (FOOT-POUNDS)**

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

¹ Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

ALUMINUM ALLOY FASTENERS ²**TORQUE (FOOT POUNDS)**

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

²Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

BOLT TORQUES FOR BUS CONNECTIONS**STAINLESS STEEL FASTENERS ³****TORQUE (FOOT POUNDS)**

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

³ Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy.

Belleville washers: 302 alloy.

TABLE 26 08 00 – A3

INSULATION RESISTANCE TESTS ON ELECTRICAL APPARATUS AND SYSTEMS

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values.

NOTE: See Table 26 08 00 - A4 for temperature correction factors.

TABLE 26 08 00 - A4

**INSULATION RESISTANCE CONVERSION FACTORS
FOR CONVERSION OF TEST TEMPERATURE TO 20°C**

Temperature		Multiplier	
°C	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

EXHIBIT B: EXAMPLE INSTALLATION VERIFICATION TEST

Project Name: xxxxxxxx xxxxxxxx xxxxx

Test Rev x.x – xx/xx/20xx

Interior Lighting Control Devices

Specification Section 26 xx xx

- ☐ First Test ☐ PASS
☐ Repeat Test ☐ FAIL
☐ Demonstrated Test

Test Date: _____

OBJECTIVES:

- A. Verify that the interior lighting controls manual light switch, occupancy sensors, vacancy sensors, daylighting sensors and motion sensor are installed per code and the design document requirements.

EQUIPMENT TO BE TESTED:

Equipment ID	Description
N/A	Manual Light Switch (single switch or 3-way switch)
N/A	Occupancy Sensors (wall or ceiling mounted)
N/A	Vacancy Sensors (wall or ceiling mounted)
N/A	Daylighting sensors (integral or external to the light fixtures)
N/A	Motion Sensors (integral or external to the light fixtures)

REFERENCE DOCUMENTS:

Document
Drawings:
Specification Sections:
Submittals:

TEST PRE-REQUISITES:

Activity	Notes	Completed?	
		Yes	No
None		☐	☐
Notes: (1)			

MINIMUM PARTICIPANTS:

Participant	Notes	Required?	
		Yes	No
Installing contractor		☒	☐
Sound Transit site quality inspector		☐	☐
Commissioning Authority		☒	☐
Notes: (1)			

REQUIRED INSTRUMENTATION AND EQUIPMENT:

Instrument or Equipment						Notes	Provided Instrumentation meets Requirements?	
Type or Sensed Parameter	Manufacturer	Model	Range	Accuracy	Calibration Date/ Next Cal. Due		Yes	No
See NETA Report				±	/		☐	☐
							☐	☐
Notes: (1)								

CONDITIONS AT TIME OF TESTING:

--

AREA OF WORK:

Area in Which Work will be Conducted:
Notes: (1)

ISSUES DISCOVERED AND PROPOSED RESOLUTIONS:

No.	Issue	Proposed Resolution
Notes: (1)		

INSTALLATION VERIFICATION CHECKLIST - GENERAL

Equipment ID	Conditions of materials at time of delivery is acceptable:	The make and model of the materials and/or equipment matches the product submittals:	The installed materials and/or equipment does not have visible damage, including finishes:	The equipment and/or distribution materials matches the locations shown on the design dwgs:	The equipment and/or distribution materials matches the locations shown on the as-built dwgs:	The manufacturer's recommended and required maintenance clearances are maintained:	Notes	Pass?		Date
								Yes	No	
Occupancy Sensors (wall mount)								☐	☐	
Occupancy Sensors (ceiling mount)								☐	☐	
Daylight Sensors (Stand Alone)								☐	☐	
Motion sensor (Integral to Fixture)								☐	☐	
								☐	☐	
Notes: (1)										

INSTALLATION VERIFICATION CHECKLIST

Sequence	Checklist Item	Notes	Pass?		Date
			Yes	No	
Manufacturer's Installation Instructions					
1.0	Verify that the attached manufacturer's installation instructions have been followed for the switchboard and accessories.		☐	☐	
Notes:					
(1)					
Specification Installation Requirement Checklists					
2.1	All devices shall be suitable for the field conditions at the installed locations. All devices shall be approved by the manufacturer for installation in the indicated environment.		☐	☐	
2.2	Protect lighting controls from dust and damage during construction.		☐	☐	
2.3	Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc., installed under other sections or by others.		☐	☐	
2.4	Coordinate the placement of wall controls with actual installed door swings.		☐	☐	
2.5	Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation.		☐	☐	
2.6	Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.		☐	☐	
2.7	Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.		☐	☐	
2.8	All lighting control system components shall be installed and mounted per manufacturer's instructions and requirements.		☐	☐	
2.9	Label all wiring, raceway, circuits, panels, components, etc., as required in the identification of electrical systems requirements as stated in the contract documents.		☐	☐	
2.10	Sensors shall be suitable for mounting in any position on a standard outlet box (except where integral to fixture.		☐	☐	
2.11	Relay power packs shall be externally mounted through a ½" knockout in a standard electrical enclosure.		☐	☐	
			☐	☐	
Notes:					

INSTALLATION VERIFICATION CHECKLIST

Sequence	Checklist Item	Notes	Pass?		Date
			Yes	No	
(1)					

SIGNATURES:

Company	Printed Name	Signature	Date
Installing Contractor:			
ST Witness:			
Other Witness:			

EXHIBIT C: EXAMPLE EQUIPMENT TEST

Project Name: xxxxxxxx xxxxxxxx xxxx
Test Rev x.x – xx/xx/20xx

NETA Testing – Switchboards and Panelboards
Specification Section 26 xx xx

- ☐ First Test
☐ Repeat Test
☐ Demonstrated Test

- ☐ PASS
☐ FAIL

Test Date: _____

OBJECTIVES:

- A. Verify that the electrical panelboards are inspected and operate to meet the design document requirements, as tested per NETA and commissioning specifications.

EQUIPMENT TO BE TESTED:

Equipment ID	Description
PB4-xx-xx	Electrical switchboard
PB2-xx	Electrical panelboard
PB2-xx	Electrical panelboard
PB2-xx	Electrical panelboard

REFERENCE DOCUMENTS:

Document
Drawings:
Specification Sections:
Submittals:

TEST PRE-REQUISITES:

Activity	Notes	Completed?	
		Yes	No
None		☐	☐
Notes: (1)			

MINIMUM PARTICIPANTS:

Participant	Notes	Required?	
		Yes	No
Installing contractor		☒	☐
Sound Transit site quality inspector		☐	☐
Commissioning Authority		☒	☐
Notes: (1)			

REQUIRED INSTRUMENTATION AND EQUIPMENT:

Instrument or Equipment						Notes	Provided Instrumentation	
Type or Sensed Parameter	Manufacturer	Model	Range	Accuracy	Calibration Date/ Next Cal. Due		Yes	No
See NETA Report				±	/		☐	☐
							☐	☐
Notes: (1)								

CONDITIONS AT TIME OF TESTING:

--

AREA OF WORK:

Area in Which Work will be Conducted:
Notes: (1)

ISSUES DISCOVERED AND PROPOSED RESOLUTIONS:

No.	Issue	Proposed Resolution
Notes: (1)		

SIGNATURES:

Company	Printed Name	Signature	Date
Installing Contractor:			
ST Witness:			
Other Witness:			

FUNCTIONS TO BE TESTED:

A.	Insulation resistance
B.	Phase rotation
C.	Installation verifications per NETA
Notes: (1)	

CONDITIONS OF TEST:

A.	Perform insulation resistance test phase-to-phase and phase-to-ground of each bus section.
Notes: (1)	

ACCEPTABLE RESULTS:

A.	Insulation resistance test voltages and minimum resistances shall be in accordance with Exhibit A, Table 26 08 00 - A3.
B.	Phase rotation shall be compatible with the serving utility.
C.	NETA inspections are all confirmed to be acceptable.
Notes: (1)	

OPERATIONAL CHECKLISTS:

No.	Checklist Item	Notes	Pass?		Date
			Yes	No	
3rd Party NETA Testing Agency					
1.1	Attach the final report from the NETA Testing Agency for all the breakers requiring testing.		☐	☐	
1.2	Verify that all of the testing has passed the acceptance criteria. Make notes of any conditions or equipment that did not pass the acceptance criteria in the notes below.		☐	☐	
Notes: (1)					

END OF EXHIBITS